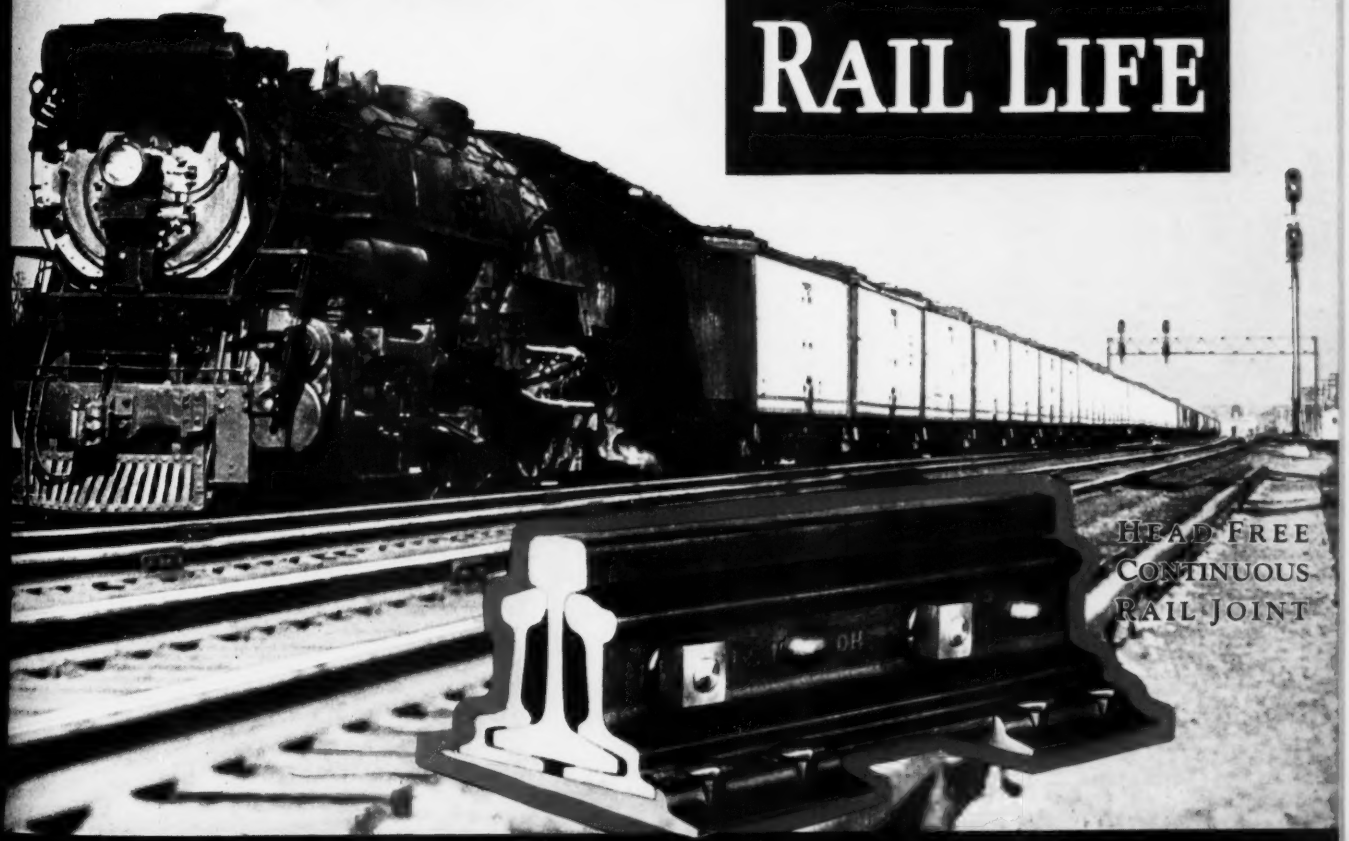
September, 1932

Railway Engineering and Maintenance

HEADFREE JOINTS INCREASE RAIL LIFE



THE RAIL JOINT COMPANY

165 BROADWAY NEW YORK, N. Y.

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THE CHESAPEAKE
Built by Septimus Norris, 1847

EVEN BETTER TODAY . . .

The Chesapeake, built in 1847 by Septimus Norris, was the first of a long lineage of ten wheel locomotives, so practical that many of a similar type are still in use.

Toncan Iron, one of the original iron alloys developed to obtain longer life of culverts in service, occupies a similar place in railroad history. Culverts of this material installed twenty and more years ago are still in service, proving the soundness of the Toncan idea. But just as locomotives have seen constant improvement, so has the development of Toncan Iron been one of progress. Today this modern alloy of scientifically refined iron, copper and molybdenum stands first among the ferrous metals in its resistance to rust, after the stainless irons and steels. Today, Toncan Iron in culverts represents a higher degree of economy than did the Toncan Iron of twenty-five years ago. Today its quality is known to railroads through its longer life in such products as boiler tubes, stay bolts, rivets, tender plates, and firebox sheets.

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TONCAN CULVERT MANUFACTURERS' ASSOCIATION
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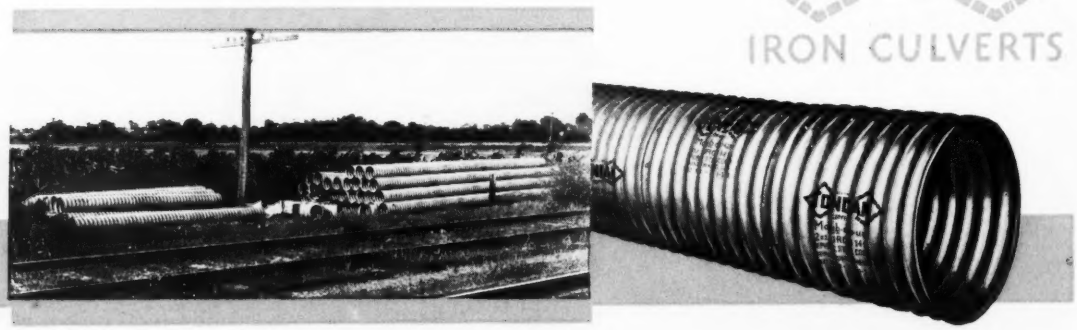
TONCAN
IRON CULVERTS



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For Utmost Economy They Must Be *Plated Properly*

ALL the care and money spent for preservative treatment is lost if tie plates are used which cut into the treated layer of the timber.

You DO get proper protection from Lundie Tie Plates. Millions in service prove it. There are no sharp projections—instead the bottom has a series of rounded steps which hold track to gauge without cutting a single fibre of the tie.

Lundie Tie Plates guard against tie depreciation. Their use effects big economies, longer tie life and fewer renewals. They assure full return from treated cross ties.

The Lundie Engineering Corporation

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THE "Caterpillar" Tractor moves into place. The All-steel Backfiller's operator engages the tractor's power take-off clutch — and another big bucket of silty muck is cleaned from the ditch and spread evenly on the shoulder. With conditions as shown, the combination was able to clean two-thirds of a mile of ditch per hour without disturbing the ballast!

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Track-type Tractors Combines Road Machinery

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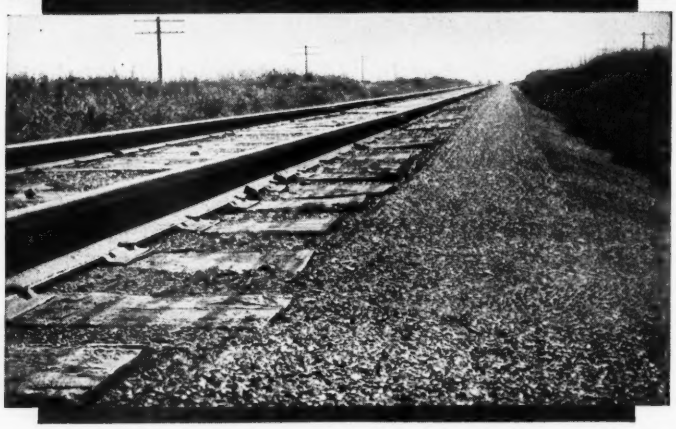
ELECTRIC TRACK TOOLS

BORING TIES AND DRIVING SCREW SPIKES



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PROPER maintenance of track is the fundamental of successful railroading. Preventing the ravages of rust and brine on rails is an important problem in track maintenance. When correctly applied Liquid Asphalt Rail Coating acts as a preventive of corrosion to rails and bolts, increases the life of spikes, anchors and tie plates, and assists in allowing the rails to expand and contract uniformly.

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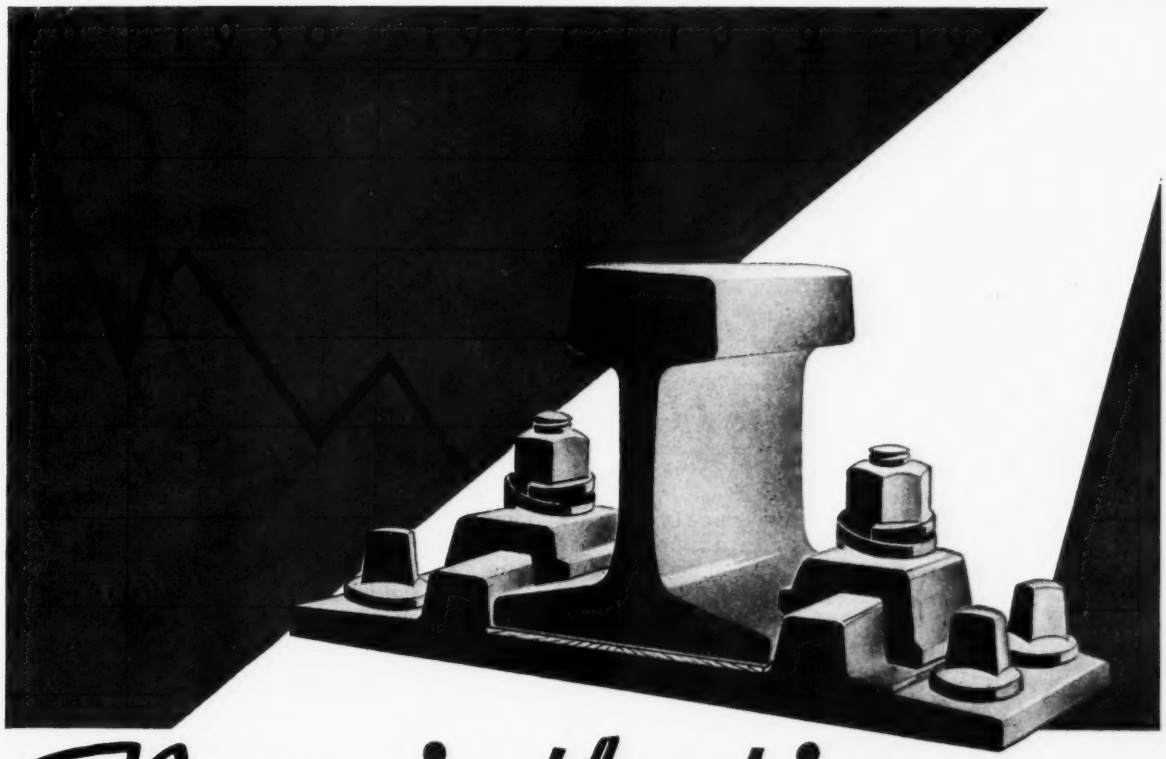

Now is the time

Periods of slack demand present an exceptional opportunity for study and experimentation with methods and materials whereby business, upon its return to normal conditions, may be more efficiently and economically transacted . . .

Many railroads have taken advantage of the times to install tests of GEO track. If you would have your track in condition for the business revival to come, there is no better time than the present to acquaint yourself with the outstanding merits of GEO Track Construction. Write for GEO Bulletin No. 2.

CARNEGIE STEEL COMPANY

Subsidiary of United States Steel Corporation

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GEO TRACK CONSTRUCTION

No. 45 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Developing Markets

August 25, 1932

Dear Reader:

As you have received your copy of Railway Engineering and Maintenance from month to month, I wonder if you have given any thought to the complete function of a paper such as this. As a reader, you see in it a medium for the dissemination of information about new and more efficient ways of doing the work that confronts you from day to day. To those of you who utilize its advertising pages, the paper serves as a medium for the presentation of your story of your products to those who are in a position to use them. But is this all?

When you drive up to a filling station and purchase gasoline for your automobile, you pay possibly 15 cents per gallon for the gasoline to take you a certain distance over the road. You also pay 3 or 4 cents more per gallon to help build and maintain the roads over which you travel and possibly to extend them still further. So it is with your advertising in Railway Engineering and Maintenance. In the rate which you pay there is included the cost of carrying your sales message to those who are in a position to buy your equipment or materials. There is also included provision for that editorial and circulation service that will open up new and extend old markets so that your message will travel still further.

If you will look back over the last decade or two, I am sure that you will note not a few fields where the steady pressure of editorial comment, month after month, has so focused the attention of railway men on certain developments (as on the economy of labor saving equipment), as to create new or enlarged markets. This is a service to those of you who are included among our advertisers which you may not have thought of. Yet, this is a very real source of expense to us, and I hope that you feel that it is of very real value to you.

Yours truly,

Elmer T. Howson

ETH*JC

Editor.

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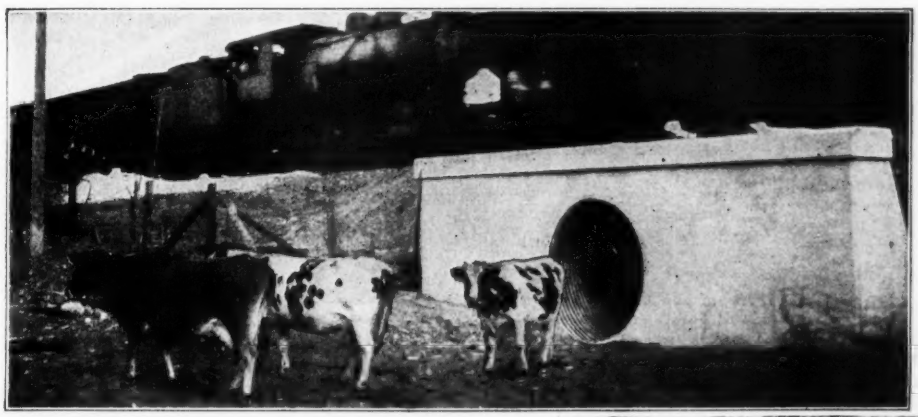
Keep Livestock off the Right-of-way with Underpasses of ARMCO Corrugated Pipe



72-inch Armco Culvert protects these fine mounts from trains on a western railroad.

Cattle plod safely homeward through this 72-inch cattlepass in Ohio.

SAFE, low in cost, and a humane solution to an age-old problem. The Method of Installation is one of marked economy. Armco Pipe is jacked through openings under the roadbed—without interruption or danger to traffic.

A railroad in Ohio solved the problem by installing a 72 inch Armco culvert—thus providing safe passage for man and animal from one side of the right-of-way to the other.

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Let us show you how Armco has helped many railroads to satisfactorily solve this problem. Clip and mail the coupon.

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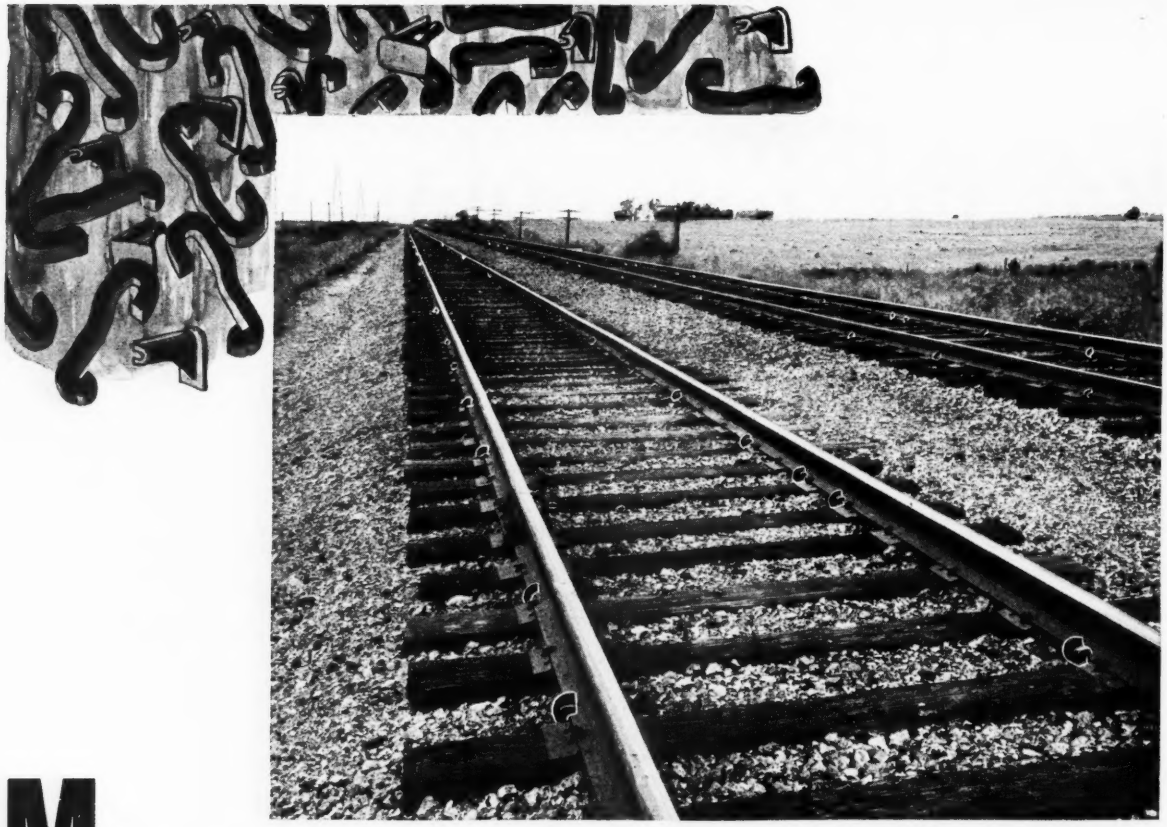

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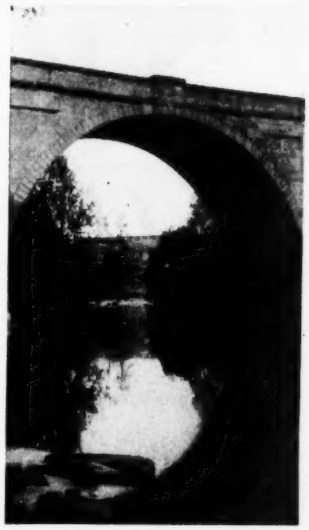

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SEPTEMBER, 1932

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ELMER T. HOWSON
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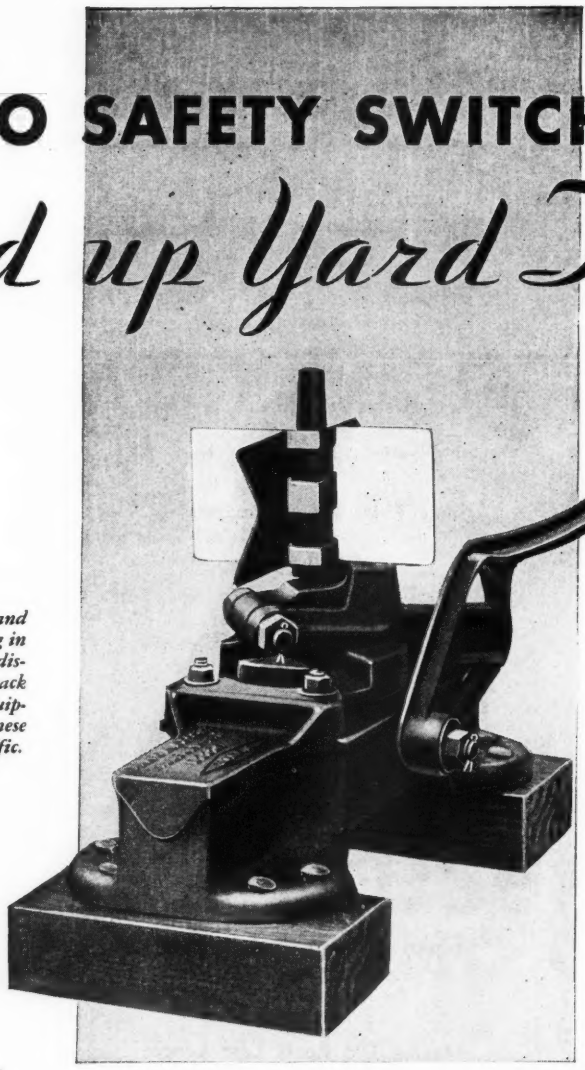
RAMAPO SAFETY SWITCH STANDS

speed up Yard Traffic



Behind Racor Service stand nine plants specializing in the manufacture and distribution of railroad track turnout and crossing equipment, including Manganese Work for heavy traffic.

The picture at left is a model No. 20 B Ramapo Safety Switch Stand with low target. A newly developed three-piece cover makes oiling and inspection easy. Write for information.

IN THE rapid handling of cars during switching operations there is the ever-present chance of shunting cars through closed switches with resultant damage to switch points and rigid switch stands. Regardless of the known hazards of such miscalculations, and in spite of the discipline with which switching crews are imbued, mishaps of this kind are frequent. Invariably, with rigid switch stands, they result in delay and expense. This constant threat of trouble makes men over-cautious and slows up their work.

Ramapo Safety Switch Stands completely eliminate all the penalties of trailing through closed switches. When this occurs, a spring mechanism allows the points to move over under pressure of the wheel flanges and properly carry the car on its way. No damage is done to the points or to the switch stand. The target follows the points and indicates their true position, whether thrown automatically or by hand.

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So successfully have these simple devices done their appointed task that more than 300,000 of them are in use on 300 railroads.

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Railway Engineering and Maintenance

WHO BENEFITS

From Government Loans to Railroads?

WHO gets the money that the government, through the agency of the Reconstruction Finance Corporation, is loaning the railroads? Is it used to fatten the treasuries of these corporations or to relieve that indefinite spectre known as Wall Street? From comments made by some supposedly well-informed persons of late such would appear to be the answer. Others contend that money so loaned goes into widely varied channels of industry and of trade and for this reason is a real antidote for the depression and a remedy for unemployment. It is important that every railway employee have a correct idea of this matter in order that he can, in turn, correct false impressions among those with whom he comes in contact.

The Reconstruction Finance Corporation (R.F.C.) was created by the last Congress, at the suggestion of President Hoover, to make available to certain industries with a high degree of public interest, funds which they could not otherwise secure, at least on any reasonable terms. Among the industries specifically mentioned are the railroads and the banks. The R.F.C. began to function early in February. In the 6½ months that intervened to August 15, 106 railroads, including 44 Class I roads, applied for loans aggregating $450,000,000. Of these requests, the Interstate Commerce Commission had, up to that date, approved loans to 60 of these roads totaling $258,000,000. The R.F.C. had, in turn, authorized, up to July 31, from the applications approved by the Interstate Commerce Commission, loans to 43 roads totaling $230,000,000 and had actually advanced $164,082,596 to these carriers.

For What Purposes?

In considering the disbursement of these vast sums, it should be remembered that they are loans, without any semblance of gifts. They are made only when amply secured by strong collateral—first mortgage bonds, gilt edge stocks, receivers certificates, etc. They are made for only three years and draw interest at six per cent, a rate so far above that which the government itself pays as to yield it a handsome profit. No fees or commissions are allowed for the negotiation of the loans, while the government checks the expenditures to insure that they comply with the purposes set forth in the applications for the loans. These disbursements, therefore, bear all of the characteristics of a strictly impersonal business transaction, with absolutely no trace of the "pork barrel" so commonly found in government expenditures.

For what purposes are these funds being used? Are they being employed for selfish or corporate purposes of the roads or are they going into channels of public benefit? A report from the R.F.C. covering its activities up to July 31 shows that of the loans approved to that date, $57,000,000 has been authorized for the purpose of paying interest due on notes, bonds and other obligations. An equal amount has been authorized to pay a portion, commonly one-half, of maturing obligations to banks and other financial houses with the understanding that the other half will be extended, thereby releasing what would otherwise become frozen assets and aiding these financial institutions in meeting runs and maintaining the normal flow of business.

Approximately $14,000,000 has been approved for the purpose of paying overdue taxes, which amounts, in many communities, contribute greatly to the maintenance of the public schools and the local governments. Loans are being used also to pay outstanding bills for material, thereby aiding in the restoration of commercial activities.

For Improvements

Still another important objective is the financing of improvement work which would otherwise, of necessity, be shut down. These loans, which totaled approximately $47,000,000 to July 31, include $27,500,000 to the Pennsylvania for the prosecution of its electrification program between New York and Washington, $10,398,925 to the Cincinnati Union Terminal Company for the continuance of the construction on its terminal facilities at Cincinnati and $4,399,000 to the New York Central for the extension of its West Side terminal improvements in New York City.

Such loans go into many channels—for labor and for materials. In a breakup of one project of this character, submitted to the R.F.C. by a prominent railroad recently, it was shown that a single loan would, if approved, be reflected in increased employment in 38 different states, involving as many as a million man-hours in a single state more than 1,500 miles from the site of actual construction. Such are the ramifications of these loans, going into almost every community, providing employment, paying overdue taxes for the support of local government, releasing funds in banks for other needs, etc.

The real beneficiaries of these loans are not, therefore, favored corporations in "Wall Street", but on the contrary, are the railway employees and the employees of those who make and sell supplies to the railways, the citizens in the cities and in the villages who benefit

from railroad taxes, etc. It is these persons who are receiving the benefit of these loans, a fact which railway employees have a very real reason to appreciate and a fact which they should disseminate among their neighbors in every way possible.

SERVICE TESTS

Should Be Made Thoroughly or Not at All

RAILWAY officers are constantly being importuned by manufacturers to try new materials and appliances, and the widespread use of most devices has grown out of initial experiments conducted on a modest scale. Similarly, conscientious and carefully watched tests of various materials of construction have also been of service in disclosing the merits of products that were subsequently applied in large quantities.

However, not all so-called service tests are conducted with adequate interest. Not infrequently an offer by the representative of a manufacturer to supply material for a test is accepted for little other reason than to get rid of him, whereupon the incident is forgotten, or if a report of the test does filter through it gets lost in the files. This practice is without justification in spite of the frequency with which requests for service tests are received, for in as much as such tests are valueless it is better not to undertake them.

Cases have been noted, also, where new materials have been tested in regular service, in which the application was not carried out in strict accordance with the procedure necessary to obtain the desired results. This has not always been the fault of the purchaser, but regardless of where the fault lies, it results in a loss to buyer and seller alike. Any material that is worth trying at all, whether it is a "free sample" or has been paid for, is worth a fair trial.

BRIDGE INSPECTION

Should Be No Relaxation in Requirements

WHEN maintenance forces must be reduced to a minimum there is a tendency to assume that men who are not engaged directly in productive work are not as necessary as those who are. While this assumption may be correct in many instances, and the work that such men do may be eliminated temporarily without serious consequences, there is one group of men within this category who should be given the most thoughtful consideration before action looking toward reductions is taken. We refer to bridge inspectors.

Bridges comprise a type of structure that must be maintained to a high standard, the responsibility being on the bridge officers. To meet this requirement intelligently and with due regard for safety, these men must know currently the condition of every structure for which they are responsible. This knowledge is doubly important at a time when maintenance is being deferred as much as practicable. It seems quite necessary, therefore, that there should be no relaxation in the rules relating to bridge inspection, but rather that they should be enforced even more rigidly than under normal conditions.

Bridge inspection should never be considered to be a minor matter which can be eliminated, or done less thoroughly or more infrequently. No road can afford at any time to consider it as a routine matter that is of little consequence. At present it becomes a matter of greater importance, which should not be neglected in any of its details.

ECONOMIES

Lean Years Develop Many Good Practices

DURING periods of drastically-curtailed maintenance it becomes necessary to do only such work as is required by the pressing needs of the moment. Under such circumstances, local maintenance officers become proficient in methods of prolonging the life of structures or their parts well beyond the limit which, in normal times, would be considered good practice.

In an article which appears on a following page, there is an interesting discussion of some of these methods as they relate to roofs. Primarily this interest lies in the ingenuity which has been exercised in an effort to extend the life of roofs and skylights while keeping expenditures at a minimum. As a matter of fact, however, there is more to this question. It often occurs that some of the practices that are developed under the pressure of sheer necessity can be continued, perhaps with modification, to advantage after the conditions which brought them about have passed.

When money is plentiful it is not uncommon to disregard some of the opportunities for economy which present themselves. When it is scarce, we eagerly take advantage of those which are plainly evident and search for others. Good judgment is needed, however, after conditions have improved, to discriminate between those methods which should be applied only as emergency measures and those which are fundamentally sound.

There is an old adage to the effect that a stitch in time saves nine. This applies to track, bridges. buildings and other railway structures with the same force that it did to raiment in the remote day of its origin. For this reason, in good times and bad, much money can be saved by correcting or repairing small defects when they first appear. Correction at this time can usually be made at nominal expense, while if a defect is allowed to develop into major damage, the integrity of the structure or some of its parts may be threatened and the cost of the repairs will be high.

An alert supervisor or foreman who observes these small defects and takes the measures necessary to correct them at the time of their inception, will find in times like these that he has much less work of a temporary or emergency character. Such a supervisor and his superior officers will also study carefully the methods which they have developed, to determine whether they can be followed to advantage after the restrictive conditions have passed.

WORK TRAINS

Power Equipment Has Eliminated Many

FOR years the work train has been considered an indispensable aid to maintenance work, although most officers have recognized that it is an expensive one. For this reason, there has always been a constant campaign on many roads to reduce the number of these trains as much as practicable.

In the past, however, when a roadmaster had a large ditching program, or was required to distribute material over a considerable mileage, he had no other recourse than to use a work train. In many cases there was no other means of transporting large gangs when it was necessary to work them temporarily at a distance from the camp greater than the economic limit for hand cars. Often they were used regularly, primarily to reduce the time lost by large gangs in going to and from their work and to insure that the men would be fresh when they reached the job.

Perhaps the most exasperating feature of work-train service is the delays which are incident to their use. They must clear all trains using the track which they occupy, and at seemingly frequent intervals—often at critical times—it is necessary for them to run for water. Furthermore, on some districts, particularly those of relatively heavy traffic, dispatchers are so busily engaged in moving revenue trains that they neglect the work train, with the result that still more serious delays are recorded. Not infrequently, the delays to which work trains are thus subjected interfere with the productive work of the gang to such an extent that this loss exceeds that of the unproductive time of the train itself.

In view of the basically high cost of work-train service and particularly of the losses which so frequently occur, it is small wonder that maintenance officers of all grades have sought methods of obtaining the desired results which at the same time will free them from the incubus of the work train. Recently it has become a general practice to provide motor cars to transport large gangs to and from work, so that this application of the work train has become of minor importance. For several years, also, heavy-duty motor cars pulling trailers have been used more and more to distribute such materials as can be handled in this way, thus making a further reduction in the need for work trains. Instances have been noted where such a motor car train has been regularly assigned to serve an extra gang for the distribution of the material which it uses.

Other changes in maintenance practices which have had an equally significant influence in reducing the demand for work trains include the use of machines of various kinds which move under their own power; the use of portable power plants for driving many kinds of tools; better drainage; and improved track construction which increases the intervals between renewals of the component parts of this structure. At present another factor is making itself felt, namely, the use of off-rail power equipment, such as ditching machines, cranes, draglines, tractors, etc., which move on crawler mountings.

As many maintenance officers visualize it, the work train of the future will be used only for loading and distributing rails, ballast and other materials, the weight and volume of which are too great to be handled by other means, and to perform those tasks which cannot be cared for by the lighter equipment which will be commonly used. In any event, owing to the increased cost of work-train service and the necessity for utilizing man-power to its fullest productive capacity, it seems certain that the next few years will see marked changes in present practices with respect to work trains.

THE FUTURE

Current Changes in Organization Not Temporary

IF ANY good can be ascribed to the current depression, it will be found in the facility with which precedent may be disregarded in these trying days. Time was, when the exponent of any program for new methods frequently encountered an insurmountable barrier in the form of some practice that "just could not be changed." It had been in vogue so long that no one could remember why it was adopted but everyone accepted it as an "established practice" which could not be altered, regardless of whatever else might be changed. Today antiquity alone makes no custom sacred and department officers and managements are willing to entertain any proposed change in method that promises economy.

While some of the maintenance practices adopted as a consequence of this change in attitude are merely expedients designed to meet the dire needs of the present, many are the logical result of the gradual mechanization of railway maintenance work during the last 15 years. They would have been adopted eventually in any case; the depression has simply served to force the issue. Thus, we find the railways adopting changes in their organization for handling work more rapidly in these days than they did in 1929, and in most cases a study of these changes will show that the new organization needs only to be expanded to be equally applicable to much larger maintenance programs.

All of these changes have been influenced by two profound developments of the period since the end of government control, namely, the widespread application of power tools and the marked increase in the strength of the track structure. Disregarding the details of the changes in organization as they have been carried out on individual railways, we find that they are prompted by two elemental considerations: (1) To get the most work out of each unit of mechanical equipment and (2) to effect a curtailment of that part of the track maintenance organization that is concerned with those routine manual operations that have been greatly reduced in volume during the last 10 or 15 years.

While the attainment of these objectives has been influenced by the emergent requirements of the depression, there has been little tendency to deviate from the movement for greater use of power tools; in fact, new appliances are being applied and new uses for old ones are being found. It is certain, therefore, that as the depression draws to an end, the changes in organization now being made will result in greater use of mechanical equipment and a further trend toward heavier and stronger track on all but branch lines of light traffic.

Rock Dams Remove Menace

Burlington employs these and other devices to overcome troubles on lines that border steep bluffs

The View Above Shows How the Rock Was Piled Up to Confine the Flow as the Bed of the Stream Filled in. At the Right Are Two Views of the Rock Dams Near De Soto

LOOSE rock dams, built of material immediately at hand have been used effectively by the Chicago, Burlington & Quincy to prevent the deposit of debris in culverts and bridge openings in locations where this problem has been the source of much trouble and expense. Like every railway that has lines bordering important watercourses in steep-sided valleys, the Burlington is confronted with the usual troubles attending the runoff from the hills or bluffs following heavy rains. Not only is the discharge in the lateral streams exceedingly rapid, but owing to the nature of the profile of these washes—steep in their upper reaches and relatively flatter at lower levels—material eroded where the flow is rapid is deposited as the velocity is retarded with the decrease in grade that is commonly encountered at or near the railway right-of-way. As a consequence there is a progressive filling up of stream beds in culverts or under bridges that reduces the effective waterway.

Source of Trouble and Expense

The discharge following unusually heavy rains frequently carries with it a burden of debris which, if stopped by some obstruction, may sometimes lead to a diversion of the flow away from the waterway under the track and introduce the hazard of a washout. But even where this does not occur, there is always the problem of maintaining the required waterway area at the bridge or culvert. In some cases there is no choice but to raise the track grade with the rise in the stream bed, but more frequently repeated cleaning out of stream beds and culverts is necessary. In more recent years, however, the efforts of the railroads have been concentrated on dealing with the hydraulics of these hillside washes at some distance upstream from the right-of-way to stop the debris before it gets too close to the track, or to go still further up into the hills for the purpose of stopping or reducing the erosion.

This article deals with the last named procedure as carried out in several locations on the Burlington by an effective yet inexpensive method involving the practical use of the very material that has been the cause of the trouble following each heavy rain, namely, the loose rock and talus debris of which the hillside is composed.

A large portion of the LaCrosse division of the Burlington lies along the base of the Wisconsin and Illinois bluffs that border the east bank of the Mississippi river. Except for exposed ledges of limestone near their tops, the faces of these bluffs consist of talus slopes composed of the debris of the disintegrating rock strata, together with soil that in most places is sufficient to support a cover of timber. The slopes are steep and the gathering of the runoff in ravines and minor valleys produces a discharge that is sufficiently rapid to carry large stones with it that are deposited farther down the bluffside where the slope flattens out.

The effect of this is clearly indicated in one of the views which shows the condition adjacent to a highway paralleling the railway. Here, the stream bed was filled level with the roadway and it was necessary to build levees of the loose stones taken from the stream bed to confine the flow so that it could be directed through the railway bridge opening.

Build Two Rock Dams

In an effort to obtain a permanent cure for a condition of this kind at De Soto, Wis., a start was made in 1918 on the construction of a series of loose rock dams beginning with a single dam at the base of the steep slope, where the flow of the water was rapid. The work was done by the section forces, using only the stone that was available near at hand in the stream bed. As soon as this was exhausted, the work was discontinued, care being taken, however, to leave the crest of the dam about two feet lower at the center than at the sides so that the discharge would be diverted away from the

# of Hillside Streams

banks and preclude the danger of a washout of either bank.

Following this initial construction, whenever subsequent runoffs brought down additional rock into the basin formed by the dam, the work was resumed until the dam was nearly as high as the banks. Later, a second dam was started at a point farther upstream where the base of this second dam would be at approximately the same elevation as the crest of the first dam.

This construction proved so effective that it was applied in a more extensive way in a ravine at Alma, Wis., as shown in the various views. Here the work was done by a special gang under the direction of a man who had been a mason foreman on the railway for many years. The basic principle of a series of rock dams was followed in the work at Alma, but was modified to meet the local conditions. In locations where the flow is especially steep, the completion of groups of dams resulted in a sort of steep stepped pavement which effectively dissipated the energy of the water spilling over it. Considerable attention was given also to the building of side walls so as to stop bank erosion, especially on the concave sides of bends in the channel, and in some places the rock was used to form a crude pavement in the slack grade locations between successive dams.

This type of runoff control work has much to commend it in talus slopes affording appreciable supplies of rock debris. It assures an effective solution of the problems imposed by stream flow on steep hillsides in such locations. The cost is moderate as the only outlay is entirely for labor—the expense incurred in handling materials up the steep slopes being avoided. The work may be carried forward by easy stages, each of which provides adequate protection until such time as further deposits of debris require the raising of the dams. At the same time, every stage in the operation marks definite progress toward a complete control of the runoff in the ravine which will be effective in stopping practically all erosion.

In other locations the Burlington has built dams of tree trunks and brush corresponding in a general way to those used extensively on other railways.* A novel expedient was adopted at a location in Iowa, where a drift catcher was constructed of old rails. These were placed in a vertical position about four feet apart, with their lower ends set in concrete in the stream bed and their tops tied together by wire cables. This fence, which was 12 ft. high in the deepest part of the channel, catches the debris, mostly brush and driftwood, and this is burned at intervals.

Two Views of the Work Near Alma. The Upper One Shows the Stepped Construction Near the Top of the Bluff, While the One at the Right Shows the Practice Followed Where the Slope Was Flatter

Trouble With Sand

Hillside runoff gave rise to an entirely different problem at Eagle Point, Ill., not far from East Dubuque, where the intermittent deposits of fine sand on the floor of an 8-ft. by 8-ft. box culvert and in the channel approach to this culvert were the source of recurring expense for the maintenance of the required waterway area. After several unsuccessful efforts to overcome this trouble, the plan of constructing a sedimentation basin was suggested by the fact that just upstream from the culvert the land adjoining the right of way, through which the sand-bearing water flowed was of little value

*Methods employed on the Erie were described in the issue of September, 1930, p. 368.

and unoccupied, and was nearly level, the slight slope being upward away from the track. Several acres of this track was purchased at small expense and a levee constructed along the right-of-way line with wings extending away from the track on each end a sufficient distance to impound the water flowing off the drainage area tributary to the culvert. One of these wing levees was carried out until its top intersected the rising slope of the land while the other wing was stopped short of this point to leave a gap for the water to flow out of the pond and thence along outside of the levee to the right of way, reaching the culvert via a side ditch.

This plan proved thoroughly effective, the levee impounded the discharge from the drainage area and it was found that the underlying strata were so pervious that they absorbed the discharge at a rate sufficient so that the water in the pond never rose high enough to flow out of the gap provided in the end of the levee wing.

We are indebted for the information presented above to C. L. Persons, assistant chief engineer, Chicago Burlington & Quincy, eastern lines, Chicago.

Some Rules for Roadmasters

By J. J. HESS

General Roadmaster, Great Northern, Seattle, Wash.

IF a roadmaster is to be successful in the administration of his duties, there are a number of fundamental qualifications that he must possess and certain rules that he should adhere to, particularly in dealing with his track foremen and their men.

Not only should a roadmaster know his foremen but he should know personally every trackman under his jurisdiction, in order that he may have the most competent and deserving men in mind for advancement when occasion arises. Moreover, he should extend encouragement to all those who try to improve themselves by letting them know that he is sympathetic with their efforts. Roadmasters should always endeavor to encourage track foremen to improve themselves in their work as well as to attain a high standing in the community in which they live, thus reflecting credit on themselves and the company they represent. They should never hesitate to compliment their men for work well performed or to criticize them when necessary.

The roadmaster should pass over his territory frequently enough to impress upon his foremen and their men that he is interested in their work. A good plan is to accompany each gang over its territory once or twice each month, stopping whenever necessary to discuss the best methods of doing the work in the most efficient and economical manner. Such a trip also affords an opportunity to make certain that rules and instructions are observed regarding the examination of switches, the safe operation of motor cars and the safeguarding of the men from accidents. The verbal discussion of any matters that may arise between the roadmaster and the foreman that is possible on such a trip is much more effective than the handling of such matters by correspondence or circulars.

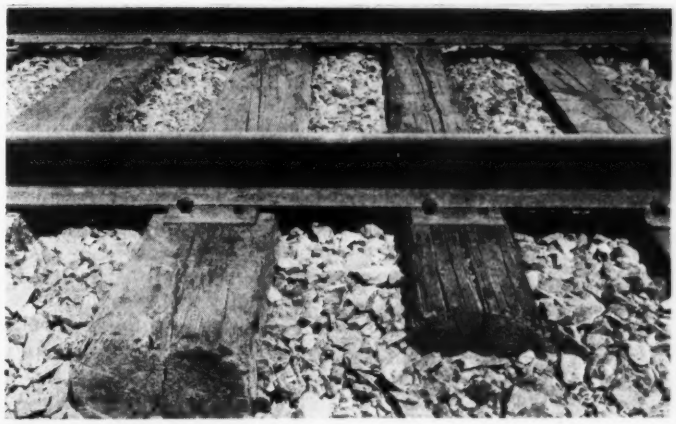
The roadmaster should always have his work outlined in such a way that, except in the case of emergencies, he knows where all gangs are located, the nature of the work that they are engaged in and the amount of work that is being accomplished daily by each gang. Moreover, he should train his foremen to map out and plan each day's work in advance and to set up an objective to be obtained at the end of the day. An effective method of determining whether a foreman is taking the proper interest in his work is to inquire what plans he has for the following day, if the work has not already been outlined by the roadmaster. If he has no plans it is an indication that he is not as interested as he should be.

The roadmaster should make certain that foremen do not consume too much time in the performance of work that requires skill and experience on the part of the foremen, such, for example, as the lining and surfacing of track. It sometimes happens that when a foreman is unable to compete successfully with others in the conduct of such work under similar conditions he offers as an excuse that his men are incompetent, when as a matter of fact his own shortcomings are the cause of the trouble. In other words, if a foreman is capable of performing such work in a minimum of time, more time is afforded the men to do a larger amount of other work with less exertion. I have never found that a good foreman will offer as a reason for his failure to compare favorably with others that his men are at fault, since he recognizes that most men do good work when under a competent foreman. The roadmaster should encourage his foremen to take part in the work where the gangs are well trained and not too large.

Another important duty of the roadmaster involves the distribution of materials of all kinds, especially rails, ties and ballast, since it is not possible to lay too much stress on the amount of time and lost motion that are saved when such materials are distributed properly. The roadmaster can also do much to aid his men by ascertaining that they are supplied with the proper tools in good repair. In this respect, it is a good practice for the roadmaster when on the road to inquire of the foremen what tools and supplies are needed and to take notes, instead of asking the foremen to write letters, which must be done after the day's work. The roadmaster should exercise great care and the best of judgment in making inspections of ties and all other materials when submitting reports on the requirements of the territory to which he is assigned. In order that he may know what the conditions and requirements are in the case of an accident, the roadmaster must know his territory so well that he can bring to mind a mental picture of the right of way in every mile.

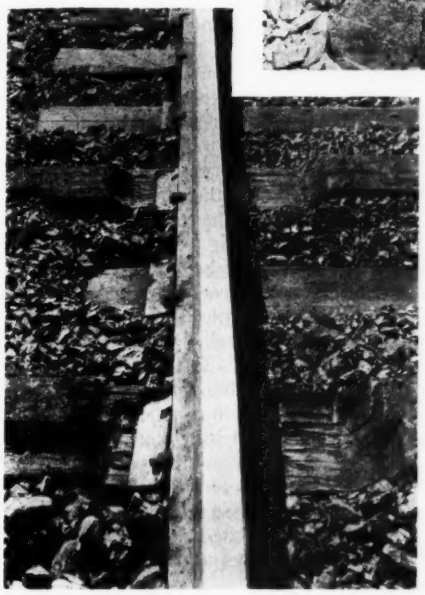
To fulfill the requirements set forth above, a roadmaster should have spent a sufficient length of time on track work to have acquired the necessary skill in the handling of men and tools and to have gained a definite idea of what constitutes a day's work.

On the La Crosse Division of the Chicago, Burlington & Quincy



An Illustration of What Takes Place When Ties of Differing Hardness Are Mixed in Track

Mixing Different Sizes Is as Objectionable as Mixing Ties of Different Degrees of Hardness



What Is A Softwood Tie?*

Lack of uniformity in the support given by individual ties when timbers of widely different mechanical properties are mixed may result in higher stresses in the rail

By W. J. BURTON
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IN giving consideration to the effect of mixing hardwood and softwood ties, the first question which naturally arises is—what is a softwood tie? The American standard tie specification does not attempt to make this distinction. Some so-called softwoods are actually harder, as measured by either average bending strength, or end or side compression, than some of the commonly-designated hardwoods. To illustrate, longleaf yellow pine is usually classed as a softwood, but it averages about 50 per cent harder, or stronger, than chestnut, although the latter is usually referred to as a hardwood.

Data on Properties Are Available

Technical Bulletin No. 158 of the Department of Agriculture contains a table of comparative index numbers for different woods and for the several mechanical properties of each. Included in the table are index numbers representing the average bending strength, longitudinal compressive strength, stiffness, hardness across the grain, etc., for each kind of wood listed. The bulletin also contains a suggested formula for combination some of these mechanical-property indices to give what is termed an index of tie strength. The suggested formula is:

$$\text{Tie-strength index} = \frac{4D + 3E + 7F}{14}$$

In which D = bending-strength index
E = longitudinal compressive-strength index
F = hardness-across-grain index

Based on this formula and the index numbers given in the bulletin, the accompanying table has been prepared for the purpose of comparing some of the commonly-used tie woods. According to this table, northern white cedar has only one-fourth the tie strength of black locust and only about one-third the stiffness. These two woods constitute the extremes for the varieties which have been included.

It is a well-accepted principle of track maintenance that uniformity is of the utmost importance. This applies particularly to the support that is given to the rail by the individual ties. Particular attention was directed to this fact by Dr. A. N. Talbot at the last meeting of the American Railway Engineering Association. Doctor Talbot's work in connection with the Joint Committee on Stresses in Track has shown that 110-lb. rail which is supported uniformly by the ties has much lower and less variable stresses than 130-lb. rail where the tie support is not so uniform. If rail stress is any indication, therefore, the lighter track is more efficient under the conditions mentioned.

Under load, all ties bend to some extent. The stiffer

*This discussion was submitted for publication in the What's the Answer department, but because of its scope it is presented here as an independent article. For further discussion of this subject, see p. 566.

the tie the less it bends under the same load and with the same ballast support. In other words, the stiffer tie distributes the load from the rail to better advantage. This results in a smaller depression of the ballast under the tie at the rail seat. These ballast depressions under the rail seat are a cause for part of the wave motion of the rail under a passing train. If they are small, the track is said to be stiff. If they are uniform, even though fairly large, the track will ride smoother than if some are large while those under adjacent ties are small. Hence, we

Index Numbers Giving Comparative Strength of Cross Ties

From Technical Bulletin 158, U. S. Department of Agriculture

Kind of Wood	Class	Bending Strength D	End Compression E	Hardness Across Grain F	Tie Strength $\frac{4D+3E+7F}{14}$	Beam Stiffness
Black locust	Hard	157	168	161	161	220
White oak, commercial	Hard	99	93	109	103	149
Oak, commercial red & white	Hard	100	92	105	101	161
Red oak, commercial	Hard	101	92	103	100	168
Beech	Hard	102	94	96	97	169
Pine, longleaf	Soft	106	123	76	95	189
Maple, red	Hard	93	87	79	85	158
Pine, shortleaf	Soft	97	104	68	84	170
Gum, tupelo	Hard	82	87	78	81	127
Pine, loblolly	Soft	93	104	62	80	166
Gum, black	Hard	83	78	78	79	118
Gum, red	Hard	86	77	60	71	134
Douglas fir	Soft	80	90	58	71	159
Tamarack	Soft	84	96	53	71	147
Cypress	Soft	79	92	52	68	136
Hemlock, eastern	Soft	72	79	51	63	121
Chestnut	Hard	68	70	50	59	112
Spruces, red, white & Sitka	Soft	71	74	42	57	136
Pine, western yellow	Soft	65	69	41	54	112
Cedar, northern white	Soft	50	52	30	40	78

may conclude that it is desirable from the standpoint of uniformity of support and smoothness of riding not to mix ties of widely varying stiffnesses. From this standpoint we should prefer to mix the better pines with the oaks rather than the gums, and to consider the latter as better suited as neighbors for cypress.

Variations in the Same Species

However, other considerations enter the problem at this point. One of these is the fact that the tabular figures represent averages of a considerable number of pieces of wood and that there is a considerable variation from stick to stick of the same kind of wood. Also, we know that tie dimensions vary considerably, especially with hewed ties, even for those of the same nominal size. We also know that it is usually desirable to use sizes 4 and 5 together and likewise to use sizes 2 and 3 together. Obviously, the larger ties are the stronger, the wood being equal. These variations may seem to mask the irregularities due to kind of wood and, yet, on theoretical grounds we can expect greater uniformity of support if we do not mix the stronger and weaker woods. In actual practice, where ties are mixed indiscriminately, a small tie of the weaker wood may be placed next to a large tie of the stronger wood, thus creating a greater variation than where both are of the same variety of wood.

Another consideration before making our final decision is that the support should not only be approximately equal where the ties are new, but it should remain so during their service life. This means that if there is any rail or plate cutting, the amount should be about equal for the different kinds of wood used together; otherwise, plates large enough to care for the softest ties must be used. If, for example, we mix shortleaf pine ($F = 68$) with oak ($F = 105$) and design plates large enough for the pine there will be an excess (waste) of metal of about 50 per cent on each oak tie. We must, of course, choose between this waste and the loss of pine ties if the plates are made to suit the oak, or somewhere between, or the extra cost involved in having one size of plate for the oak and a larger size to be used in connection with pine ties.

Influence of Tie Plate Bearing

The behavior of mixed lots of strong and weak woods is complicated also by the extensive use of tie plates designed to bed themselves under traffic into the uneven surfaces of hewed ties. This is not so much a matter of damage done to the ties, since modern designs of tie plates are far better in this respect than the early types. The principal difficulty arises from the fact that ties vary widely in hardness while there may be even wider variation, as where a knot is encountered, within the area upon which an individual tie plate is applied. For these reasons, tie plates of this type often do not seat uniformly, nor do they ever seat themselves at the time of application, but must await the passage of one or more trains. This deferred seating of the plates is one of the reasons for the difference between the fine surface which the section foreman observes when the track is not under load and the true surface under the train.

A rib or ribs on the plate, parallel to the rail, which will fit into corresponding grooves in the pre-adzed surface of the tie are not objectionable and these ribs assist materially in obtaining and holding true gage and in keeping the plates square. A further step is the adoption of a standard distance between the grooves on the two ends of the tie so that differences in the width of the rail base may be accommodated by varying the position of the ribs on the plates used with different rail sections. In this way rail changes are simplified and tie life greatly increased.

With plates having the ribs fitting into grooves precut in the ties, the spikes are relieved of a considerable part of the thrust which occurs on curves, and for this reason the advantage which the harder ties have is somewhat overcome. It is to be noted that end compression (column E of the table) is more nearly uniform for most of the woods; in fact, the southern pines are better in this respect than the oaks. It is this end compression which is advantageous in backing up the spikes.

But on curves there is also another consideration. When the speed of freight trains is slower than the speed for which the curve is super-elevated the inner rail carries more than its share of the load, and when trains run faster than the equilibrium speed the outer rail is similarly superloaded. This extra load means that plates which are just large enough to protect the ties on tangent may be too small on curves.

All of this discussion is, of course, purely theoretical and it would be better, were it possible to do so, to base conclusions on this subject on actual trial and experience. Unfortunately, such trial cannot be made without the lapse of years, during which many things are almost certain to happen to mask the causes of the observed effects and to make any results even more doubtful than those obtained by a theoretical consideration. In any given case, too, the desirability of mixing hardnesses must be weighed against the undesirability and it is very probable that in some cases the advantages will outweigh the disadvantages.

To sum up, from theoretical considerations, it is undesirable to mix ties of woods having widely different mechanical properties.

Modernizing Branch Line Bridges

Norfolk & Western strengthened or renewed 19 structures on line in Virginia—Several were raised

One of the Old Phoenix Truss Spans of Bridge No. 1509 and One of the New Warren Truss Spans that Replaced Them

TO overcome highly disadvantageous operating conditions on its North Carolina branch in Virginia, due mainly to the insufficient size and capacity of its bridges, the Norfolk & Western recently completely overhauled the bridges on this branch, which involved the renewal, strengthening or raising of 19 single-track structures, together with considerable pier and abutment work. At the same time, it also realined many sharp curves, improved the roadbed at many points by the addition of slag ballast, and strengthened the 85-lb. track structure over a considerable mileage by relaying it with 100-lb rail. The entire project involved an expenditure of approximately $700,000.

Was Constructed in the Eighties

The North Carolina branch, which extends from Pulaski, Va., on the Bristol line of the road, south to Galax and Fries, Va., about 52 miles, was constructed in the eighties when equipment was light, presumably with the idea of extending it eventually into North Carolina. Comparatively speaking, the track structure was light, the alinement was quite severe, and the bridge structures, except in a few instances where renewals had been made in recent years, were designed for a load limit of approximately Cooper's E-30. To meet different conditions with regard to span lengths and clearance over highways and water courses, the old bridges were of a number of different types, including both deck and through trusses, plate girders, and timber trestles, these different types of construction frequently being included in the same structure. Many of the old truss spans were made up of wrought-iron, pin-connected Phoenix trusses, which were fabricated and erected by the Phoenix Bridge Company at the time the line was built, and had thus been in service nearly 50 years.

For many years the original structures served adequately, but in recent years, owing to the increase in the size and weight of power, and, to an even larger extent, to the increased size and loading of cars, the old bridges presented a serious operating problem, with disadvantages to both the railroad and shippers. Not only was it necessary to maintain unsatisfactory power on this branch, but restrictions were in force with respect to both the size of cars and weight of loads. This latter factor put shippers on the line at a disadvantage both in forwarding and receiving materials. Loads originating on the line were restricted far below main-line loadings, and many shipments consigned to industries on the line had to be restricted in size and weight per car, or broken up and reloaded into smaller cars before they could be permitted to be moved over the line.

With the prospect of increased traffic on the branch, and a desire of giving additional employment to as many of its bridge and building forces as possible, it was decided to overhaul the branch to bring it up to the requirements for a number of years to come. In this work, which required approximately ten months, employing over 200 men, all of the bridges were renewed or strengthened to a rating of Cooper's E-55, or sufficient to carry the second heaviest locomotives on the road without restriction to speed, and even the heaviest locomotives with a speed restriction of 15 m. p. h.

In all of the bridge work, the most extensive and interesting was in connection with bridges No. 1509, near

Hiawassa, No. 1518, near Ivanhoe, and No. 1551, near Fries Junction, all of which carry the line over the New river, a rather wide but shallow stream under normal flow, with a rock bed. Bridge No. 1509 consisted of a group of five wrought iron Phoenix through truss spans, each 168 ft. long and skewed 32 deg. This bridge was completely rebuilt. All of the old trusses were replaced by riveted Warren trusses, while two 30-ft. deck plate girder approach spans were added at the south end and one such span at the north end. Furthermore, to increase the under-clearance of the bridge and thereby preclude the possibility of damage by floods, which have threatened the old bridge in the past, the new spans were placed at an elevation sufficient to raise the track 6½ ft. Coincident with this work, which required the building

Left — New Warren Deck Truss Spans Relieving the Old Deck Truss Spans of Bridge No. 1518

Below — The Old Phoenix Truss Spans of Bridge No. 1509 Giving Way to Stronger Warren Truss Spans at a Higher Elevation

up of the old stone masonry piers and abutments, all of the piers and the abutments were completely encased in a jacket of concrete.

The first step undertaken in carrying out the renewal of this bridge was the encasement of the piers and abutments from the rock river bed up to points just below the old caps. In effecting this, timber cofferdams were constructed around the footings to permit the placing of the concrete in the dry. The encasement, which was made from 18 in. to 24 in. thick, was reinforced both vertically and horizontally with ¾-in. round rods, and was anchored into the old masonry by means of expansion-end anchor bolts on 4-ft. to 5-ft. centers.

Jacking Under Difficulties

With the concrete encasement completed almost as high as the caps of both the piers and the abutments, raising of the spans was undertaken uniformly across the entire structure in increments of from one to two inches at a time. This work was done in a rather unusual manner in that it was necessary to pick the spans up by means of yokes looped around the end pins because it was found impracticable to apply jacks under the bearings. In this work, the nuts on the old end pins were removed and were replaced by round steel extension pieces, or pins, about 6 in. long. Heavy U-shape steel straps were then placed under the extension pins, with their free ends, which were threaded, extending upward on each side of a short heavy-section I-beam header piece, and tied across the top by means of steel bars. With jacks placed beneath these headers and blocked up as raising progressed, the full raise of the bridge was carried out, working entirely from the tops of the old piers. Raising of the track approaches continued simultaneously with that of the spans, so that at any time, on short notice, the bridge could be opened to traffic.

With the spans at the new elevation, the tops of the existing piers were dressed to a smooth surface and new steel grillages were placed to receive the shoes of the new trusses. Owing to the greater vertical distance from base of rail to bridge seat in the new spans than in the old spans, it was necessary to place temporary blocking on top of the new steel grillages to support the shoes of the old trusses. After this was done, timber bents were placed on both sides of the piers, with their sills resting upon the new concrete casings, and were made to support the outer, or pier ends of the end stringers.

Thus supported, the timber blocking which had been placed under the pier ends of the stringers was removed, and a new concrete stringer block was cast in position on each existing pier. After the concrete in these blocks had set for two weeks, the end stringers were given

support on the blocks through timber blocking, and then the timber bents were removed. Following this, the new concrete casing across the tops of the piers was completed, this, in each case, extending up to a point level with the tops of the new steel grillage seats, and down on all sides to the top of the side concrete casings which had been constructed around the piers.

Old Spans Supported and Then Dismantled

Renewal of the spans themselves was effected one at a time, and in this the first step was to drive falsework pile bents under each panel point. With a span thus supported the trusses were dismantled, piece by piece, using acetylene torches and a locomotive crane, the floor system remaining in place. As soon as the old trusses of a span were removed, the new Warren riveted trusses were erected in their places. Erection of the new trusses was facilitated by the fact that these trusses were spaced 18 ft. center to center, whereas the old trusses had been on 16 ft. centers, but, in spite of this increased width, the ends of the old floor beams had to be burned off to permit erection of the new steel. The last step was to replace the old floor system with the new.

In a more or less similar manner, the spans of several other bridges were renewed, the most notable instance being in the case of bridge No. 1551, the longest on the line. This bridge, which is 1,058 ft. long, was composed of five Phoenix pin-connected through trusses, each 114½ ft. long, a 112½-ft. riveted Warren truss, erected in 1928, two deck plate girder spans, and about 250 ft. of timber trestle, the latter having been constructed in 1918 to replace sections of the old steel structure carried away by high water and an ice gorge. The rebuilt structure, which was raised approximately 7½ ft., well above record high water, to prevent the repetition of the damage which occurred in 1918, consists of 13 spans, including five 114½-ft. through plate girder spans, which replace the old Phoenix trusses, the Warren truss span which was renewed in 1928, and seven deck plate girder spans, from 50 to 63 ft. long, which replace old girder spans and the timber trestle section of the old structure.

Following its general practice of using "fit" material where possible in the strengthening of bridges on branch lines, a 63-ft. deck girder span in the old structure was renewed completely, but the girders released were shortened and doubled up with the old girders of a 54-ft. span of the bridge to secure the increased strength desired in that span.

Seven of the old piers were heightened and encased in concrete, in a manner similar to that employed in the case of bridge No. 1509; the abutment on the north end was rebuilt; and four new piers and a new south abutment were constructed to carry the girder spans replacing the old approach trestle.

Four Deck Trusses of Bridge Renewed

Another of the major renewal jobs on the line was that in connection with bridge No. 1518, a structure 680 ft. long consisting of four 140-ft. deck truss spans of the old Phoenix design, and two 48-ft. deck plate girder approach spans, one at each end. Here, the old truss spans were renewed with Warren deck truss spans of the same length, while one of the girder approach spans was replaced by stronger fit girders removed from a main-line structure, and the other strengthened by adding to it the girders of the same length removed from the approach span at the opposite end of the bridge.

With the base of rail already about 60 ft. above the river, there was no necessity for increasing the height of the piers, although several of them were completely encased with concrete while the remainder were encased about their footings to a height just above mean flow level. The elevation of the base of rail on the renewed bridge is somewhat higher than that on the old bridge, but this is due entirely to the increased depth of the new trusses and floor system.

The remainder of the bridge work on the line had to do with shorter and less important structures than those described, and offered no special problems or difficulties. In this work piers were strengthened, encased and increased in height as was found necessary, a number of pony trusses were replaced with girder spans, existing girders were renewed or strengthened, and many sections of timber trestle approaches were given increased carrying capacity through the renewal or the addition of bents and stringers.

Altogether, the bridge work in the North Carolina branch involved the use of approximately 3,000 tons of steel, 500,000 ft. b.m. of timber, and about 5,800 cu. yd. of concrete. Approximately 25,000 cu. yd. of earth and 500 cu. yd. of cinders were used in revising the approaches to the raised bridges.

Doubling Up the Deck Girder Spans of Bridge No. 1551

With the exception of the steel work on the three larger river bridges, Nos. 1509, 1518 and 1551, which was fabricated and erected by the Virginia Bridge & Iron Company, Roanoke, Va., all of the work was done by company forces, under the general supervision of W. O. Franklin, superintendent of the Radford division. The work was planned and executed under the direction of W. P. Wiltsee, chief engineer, and A. B. Stone, bridge engineer.

STOLE A LOCOMOTIVE—Arthur Whipkey had a date with his girl recently and decided to drive over to her house in a locomotive. The roundhouse forces of the Baltimore & Ohio at Uniontown, Pa., finally convinced him that stealing a locomotive is not quite the thing to do, but not until after he had derailed one engine and made valiant efforts to steal another. Arthur promised the judge that he would never steal another locomotive, no matter how much he wants to see his girl.

A View Showing the Pans, the Covered Melting Lines and the Concrete Slab Paving

Track Pans
Without the Usual Problems

Effective features are incorporated in supply, drainage and heating systems of the New York Central's four-track installation near Rome, N. Y.

TRACK pans are considered by a number of roads as a requisite of modern water supply systems in dense traffic territory and have resulted almost invariably in operating economies, although they have almost always presented difficult maintenance problems, especially in locations subject to freezing weather and heavy snows. That many of these latter problems can be overcome, however, by proper construction, is evidenced by the four-track installation on the New York Central near Rome, N. Y., enlarged and modernized recently, where, although on one of the coldest and most snow-swept sections on the road, the water heating, snow and ice melting and drainage systems provided are so effective that track and pan maintenance have been reduced to a minimum the year around.

In the original installation near Rome, only the two passenger mains were equipped, and with only what might be classed as ordinary construction, whereas the present installation includes the two freight mains and a number of special features in surface and sub-surface drainage, water warming, snow and ice melting and water supply delivery, control and registering, which make it possibly the most efficient pan installation on the road.

Prior to 1922, when the two pans of the initial installation were equipped only with water warming lines, from 40 to 60 men, and at times as many as 100 men, were employed in snow and ice removal work around the pans during the winter. In 1922 snow melting lines were installed and immediately the snow and ice problem was practically solved. Since that time the pan maintenance force has been held to eight men during the winter, assisted only at infrequent intervals by the regular section forces in matters pertaining solely to the track structure.

With the further modernizing of the old facilities recently, and in spite of the extension of the pan service to the two freight mains, the winter maintenance force has been cut to seven attendants, and the larger part of this force is employed in the operation of the boiler plant in connection with the water warming and snow melting systems. The present summer force consists of only one attendant who keeps the pans free from debris and attends to the water metering devices.

The importance of the station at Rome is seen in the fact that from 58 to 62 passenger trains and from 13 to 15 freight trains take water at this point every 24 hours, and furthermore, in the fact that the water consumed ranges from 29,000,000 to 35,000,000 gal. a month.

Long Pans Installed

In spite of the severe winter conditions which prevail in the Mohawk valley, the site of the pan installation near Rome was selected both because of its advantage from an operating standpoint and because the tracks here are on a fill which offers an opportunity for favorable track drainage. The tracks lie in a general east and west direction and the four main tracks, from south to north, are numbered 2, 1, 3 and 4, respectively. Track No. 2 is the eastbound passenger main; track No. 1 is the westbound passenger main; track No. 3 is the westbound freight main and track No. 4 is the eastbound freight main. Tracks 2, 1 and 3 are grouped together with track centers of 13 ft. and 16 ft. 2 in., respectively, but track No. 4 is located about 200 ft. north of track 3 and is separated from it by a group of yard tracks.

The pans in both passenger mains are 2,000 ft. long, while those in the freight mains are each 2,500 ft. long, the longest on the road. Except for this fact and the further fact that one of the pans is of welded construction throughout, while the other three are of riveted

construction, all four pans are alike. They are 20 in. wide and 8 in. deep, inside measurement.

The water supply at the Rome station is secured ordinarily from the city of Rome, but a Worthington compound duplex pump of suitable capacity is located in a boiler plant near the pan installation, which can supply the pans from the New York State barge canal nearby if the city supply should fail for any reason. Temporary reserve to insure adequate water during periods of peak demand is afforded by two 100,000-gal., tower-type steel tanks and a 50,000-gal. wooden tank, all three of which are connected in a system whereby they can supply any of the four pans.

General View of the Boiler Plant at the Rome Station, Showing One of the 100,000-Gal. Steel Tanks

Float Valves Control Supply

All of the four pans have their own individual intake lines, control apparatus and flow registers, but because of the proximity of Tracks 1, 2 and 3, the pan installations in these three tracks can be considered more or less as a unit, in reality a triplicate of the installation in Track 4. For this reason, this article deals largely with the three-track installation.

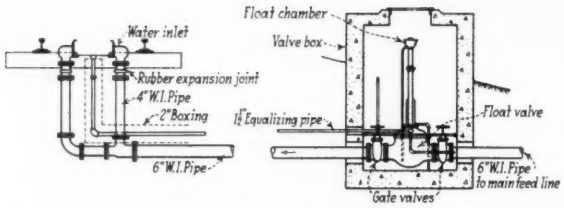
From the main supply lines, which are largely of 14-in. cast iron pipe, 6-in. wrought iron feed lines extend to the different pans at intervals of about 355 ft. In passing to the pans, each group of feed lines enters a covered reinforced concrete valve box, with inside dimensions of 10½ ft. by 4½ ft. by 7¼ ft. deep. Within these boxes, of which there are seven for the three-track installation, each feed line is equipped with a 6-in. automatic float valve, on each side of which is a 6-in. gate valve. Normally, the two gate valves are open and the flow of water to the pans is regulated entirely by the float valves, the primary purpose of the gate valves being to enable the float valves to be cut out for cleaning or repairs.

The float valves have their float chambers at the elevation of the track pans and the floats are connected to the valve chambers several feet below by rods passing through vertical pipes. With a 1½-in. equalizing pipe extending beneath the tracks from each float chamber to the specific pan served, any reduction in water level in any of the pans is reflected in the opening of the appropriate supply valve. In each case, the connection of the equalizing pipe with the pan is about 25 ft. ahead of the water inlet on the approach side. This places it ahead of any turbulance due to the inrush of water at the inlet, and at the same time starts the valve action for refilling the pan even before a locomotive water scoop reaches the points of inlet. From 15 to 18 sec. are required after the reduction of the water level at the equalizing pipe opening to produce full opening of the supply valve.

There are two inlets at each point of inlet in the pans, one on each side, through the side. These inlets have 4-in. connections to the 6-in. line from the valve and are of special interest because of their shape and also because of the manner in which they are connected to their supply lines. The inlet fittings themselves are special castings with a standard bolted flange connection on their lower or inlet end, and a 24-in. pan connection plate, with a long narrow discharge orifice, which is bolted to the side and bottom of the pan. This type of inlet is designed to discharge the water in a horizontal plane in a direction opposed to the direction of traffic, and thus not only forces the incoming water toward that part of the pan emptied by reason of locomotives taking water, but also permits the full discharge opening of the valve and, therefore, full discharge from the inlet without the splashing over and waste of water about the inlet. Only 1½ to 2 min. are required to refill a pan after a train has taken water, a factor of considerable importance on this section of the line where a number of passenger trains run on close headway.

Another feature about the pan inlets is the flexible connection through which they are joined to the 4-in. feed lines. Formerly, with a rigid pipe coupling between the supply lines and the inlets, leakage and breakage were common by reason of expansion and contraction, the wave motion in the tracks under traffic and the surfacing work of the track forces. To overcome this difficulty, a corrugated vulcanized rubber coupling about 8 in. long, with standard flanged joint ends, was designed, which permits about 1¾ in. of longitudinal movement between the fixed end of the supply pipe and the pan inlet. This expedient, in use at all of the inlets, has eliminated all

Looking East Along Track 2 and its Paved Outside Shoulder—Steam Line on the Right



A Section at One Track and a Valve Box, Showing the Water Supply Layout

connection trouble experienced previously at these points.

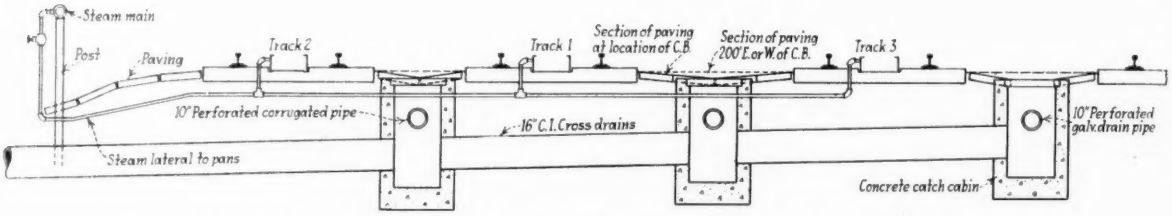
Another feature is the water-level gage applied to each pan, not alone to secure a record of the water level in the pans at all times, but also to secure a record of the number and times of trains taking water, the approximate quantities of water taken, and the rapidity with which the pans are refilled. The gages used are Bristol water-level gages, which are clock-pen mechanisms which produce an ink graph on a circular chart which is divided radially into inches of water and circumferentially into hours and fractions thereof.

The three gages from Pans 1, 2 and 3 are located in one of the valve boxes near the mid-point in the length of the pans, while the gage for Pan 4 is located in one of the valve boxes in connection with that pan. Each gage is connected to the pan served by means of a metal tube, which transmits the changing water head pressure in the pan to the gage mechanism.

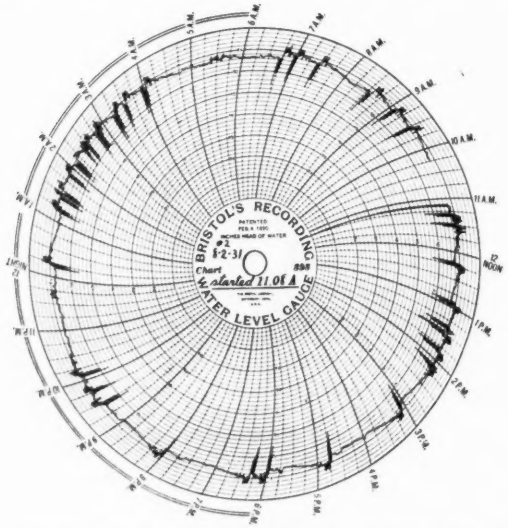
To insure the best possible track and operating conditions at the pans during both summer and winter, the tracks were completely resurfaced on clean stone when the enlarged installation was made; the entire roadway between tracks and on the shoulders of the outside tracks was paved with concrete slabs; a complete system of subdrainage was provided; the pans were equipped with steam inlets to prevent the freezing of the water; and, in addition, steam lines for preventing the formation of ice and the accumulation of snow were provided on the tie ends throughout the length of the new pans and well beyond their run-off ends.

In the subdrainage system provided, lines of 10-in. Armco, perforated corrugated iron pipe extend longitudinally between Tracks 1 and 2, between 1 and 3, and also between Track 3 and a siding adjacent to it. These drains are pitched 6 in. in 100 ft. with summits and low points located alternately at intervals of 200 ft. At all low points, which in the different lines lie directly opposite each other, concrete catch basins are provided, with cast iron grating covers. These basins are joined across the roadway by 16-in. cast iron cross drains pitched 6 in. in 25 ft., which empty into a low drainage ditch along the south side of the right-of-way.

To promote cleanliness and rapid surface drainage, the area between Tracks 1 and 2, between Tracks 1 and 3 and between Track 3 and the siding adjacent to it, as well as the outside shoulder of Track 2, are paved with concrete slabs, the paving in the inter-track space being pitched suitably to form troughs leading to the different catch basins of the sub-surface drainage system. These slabs, which are essentially in two sizes, 20 in. by 20 in. and 20 in. by 25 in., and 4 in. thick, were all manufactured alongside the pan installation and were moved into position on push cars for placing.



Section Across the Three-Track Pan Installation, Showing the Surface and Sub-Surface Drainage Systems Provided

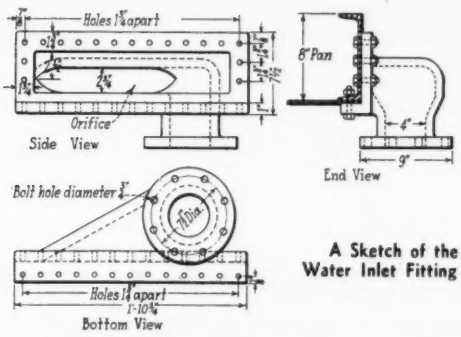


Typical 24-Hour Chart Made by the Water-Level Gages with Which the Pans are Equipped

Heating Systems are Effective

The water heating system for Pans 1, 2 and 3, which is designed to keep the temperature of the water above 50 deg. in even the coldest weather, consists of a main steam supply line approximately 2,700 ft. long along the south side of the right-of-way, with laterals at intervals of 32 ft. leading under the tracks to steam jets in the near side of each pan. The main supply line, which is reduced at regular intervals from a diameter of 8 in. at the supply end to 2½ in. at the far end, is carried on posts at a level of about a foot above the tracks, and for this reason is heavily insulated. The laterals start with 1½-in. pipe but are reduced to ¾ in. at the outer ends. This main steam line also supplies steam to the snow and ice melting system, which, otherwise, is entirely independent of the water warming system.

In the snow melting system, two-inch pipes, with intakes and condensate relief traps at intervals of about 350 ft., lie outside along both track rails. These lines are covered with galvanized iron shields, semi-circular in section, which are nailed to the ties and are designed to assist in radiating the heat from the lines. For several hundred feet beyond the run-off ends of the pans, where there is considerable overflow from the pans and dripping from locomotive tenders, there are four lines of covered melting pipes.

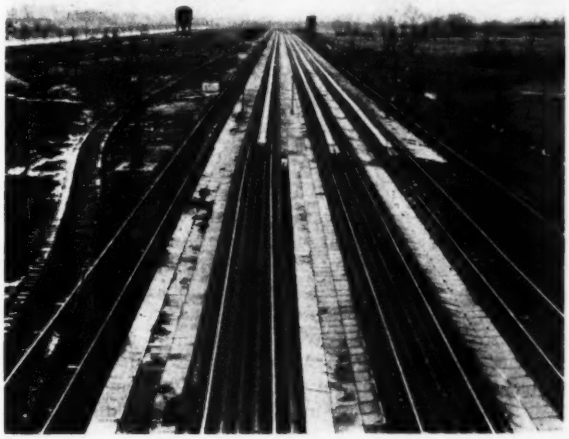


A Sketch of the Water Inlet Fitting

Steam for the water warming and snow melting systems is supplied by a boiler plant, enlarged and modernized with the extension of the pan system, which is located near the west end of the pans on the north side of the tracks. This plant, which is a brick structure about 150 ft. long by 75 ft. wide, is equipped with three low-head, water-tube boilers. Two of these boilers are normally kept in operation during the winter, carrying approximately 125-lb. pressure, and the steam is fed to the lines at approximately 80-lb. pressure.

In all main respects except sub-drainage, the pan installation in Track 4, the eastbound freight main, is similar to the larger installation in Tracks 1, 2 and 3. Like the larger installation, the single-track installation is provided with heating and melting systems and the roadbed is paved with concrete slabs to insure rapid run-off. No sub-drainage is provided in this installation because of the elevation of the track, the fact that it is located by itself, and the further fact that the paving keeps most of the splashed water away from the immediate roadbed.

Weather conditions during the last winter were far from typical of those which normally obtain in the vicinity of Rome, but such snow conditions and freezing as did prevail were sufficient to demonstrate the adequacy of the drainage and heating facilities provided to meet even the most severe winter conditions without the employment of large ice and snow removal forces.



Looking East Over the Track Pan Installation—A Fourth Pan is Located in the Group of Tracks at the Left

The installation described was carried out by the maintenance of way department under the direct supervision of T. P. Soule, supervisor of bridges and buildings, and F. L. Vault, supervisor of track.

Canadian National Equips Diver with Telephone

TO FACILITATE and speed up the under-water inspection of timber or masonry structures, the Central region of the Canadian National has equipped one of its diving outfits with a two-way telephone system whereby the diver and his attendant above water can be in constant communication with each other. This new equipment, which is the first of its kind to be used on the Canadian National and is not commonly used on other roads, is estimated to save approximately 50 per cent in the actual under-water time of the diver and, furthermore, to minimize the hazards of his work.

The telephone system, which is designed specifically for the purpose, consists essentially of a telephone transmitter and receiver mounted in the diver's helmet, another transmitter and receiver for the use of the diver's attendant above the surface of the water, a portable telephone equipment box or case which houses a group of transformers and dry batteries required to supply current to the telephone transmitters, and a suitable length of waterproof telephone cable.

View Showing the Different Units of the Two-Way Diver's Telephone Equipment Employed on the Canadian National

The telephone equipment was applied to a standard diver's helmet in the manner shown in one of the accompanying illustrations. The transmitter button is located in a recess at one side of the observation port, mounted on a rubber cushion to prevent vibration or jars to the helmet being conveyed to it, and is protected on its inner side by a metal shield and wire screen. The receiver is mounted directly in the center of the top of the helmet with its diaphragm toward the helmet and about ¼ in. away. Through this method of mounting, it employs the helmet as a resonant board or loud speaker shell in amplifying the sounds which it produces, thereby making it unnecessary to locate the receiver near the diver's ear where it might be the cause of injury to the diver or become damaged itself.

Electrical connection between the equipment in the helmet and the power supply and auxiliary equipment

in the equipment case is effected by means of a rubber-covered cable which, when in use, is usually coiled around the diver's air supply line to keep the two lines together. The above-water end of the cable terminates in a special plug fitting, which is readily attached to or detached from the equipment case, while the under-water end is permanently attached to the helmet through which it passes to a group of terminals on the inside. These terminals, which afford connection with the wiring within the helmet, are covered with a hard rubber cap to protect the diver's head from the possibility of coming in contact with them.

The telephone equipment used by the diver's attendant consists of a breast-plate transmitter and a watch-case receiver equipped with a head band so that the attendant can maintain constant communication with the diver while moving about and with his hands entirely free.

When the telephone system is not in service, the under-water cable is detached from the equipment case and, with the helmet, to which it is fixed permanently, is handled as a unit. The attendant's telephone set fits into a compartment provided in the equipment case.

Interior of the Diver's Helmet, Showing the Arrangement of the Receiver, Transmitter and Line Terminals

Because of the water-tight construction of the equipment case, when closed, it is entirely waterproof and can be subject to rain or dampness without damage.

The Central region maintains a licensed diver in its employ, who, when not engaged in diving, is taken into one of the bridge repair gangs. In this way, the services of a diver are always available for either routine or emergency work. In fact, to insure this, several other men in the bridge and building department are being trained in under-water inspection work.

The principal advantages to be gained through the use of the telephone equipment are speed and accuracy in subaqueous inspection and increased safety. With the equipment, it is expected that approximately 50 per cent of the actual diving time will be saved through making it unnecessary to bring the diver to the surface at short intervals to report. From the standpoint of safety, it is expected that the equipment will relieve the diver of intensive memory work, which is particularly advantageous since it has been found that it is not safe to trust too many details to a diver's memory, particularly if conditions below are such that movement is difficult or dangerous. In the case of emergencies, such as the diver becoming trapped or his air or life lines becoming fouled, it is expected that the telephone equipment will be invaluable in co-ordinating the efforts of the diver and the above-water crew to correct conditions. Such experience as has already been gained with the telephone equipment has proved so satisfactory that it is planned to equip another diving unit with similar equipment.

The equipment described was installed by the Canadian National Telegraphs under the direction of J. C. Burkholder, chief engineer, and is being used by the bridge engineer's department under the general supervision of C. P. Disney, bridge engineer.

Making Old Roofs Last Another Year

By H. J. BARKLEY

Bridge and Building Foreman, Illinois Central, Carbondale, Ill.

IN THESE days of greatly reduced maintenance appropriations, building supervisors are often called upon to make a roof weather proof for another year, which in ordinary times would be scheduled for renewal. Often this job includes the ever-troublesome skylight. Sometimes the roof sheathing is soft and the ordinary 2-in. roofing nail will not hold, this occurring most frequently for a width of a few inches to a few feet along the edge of the roof. To remove such a section means new sheathing and new roofing.

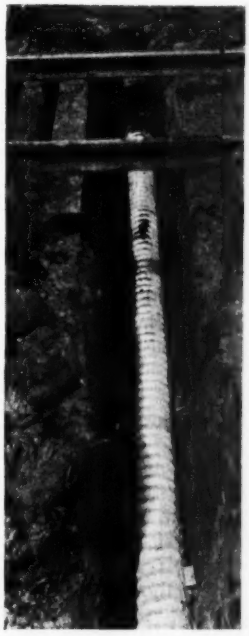
In several instances we have "stripped" such a roof with wooden slats of 1-in. by 2-in. pine lumber, held in place by heavy nails which pass also through the roofing and the sheathing into the rafters, and have then mopped the surface with ordinary roof paint or a tar and pitch combination. For this expedient it makes little difference whether the roofing is metal, gravel or paper. After the edges of the roof are secure, we patch the leaks with the same material as the roof and mop it. In nearly every case we use a cheap roof paint with a coal-tar base and roof cement, although, if the roof is worth it, we would be warranted in using an emulsified asphalt which costs more and will probably last longer. Old paper (ready roofing) can sometimes be kept weather proof and usable for years in this way.

Rusted-out holes in skylights and gutters can be patched very cheaply by tearing old cement sacks into the proper size, dipping them in paint or roofing paste and then laying them over the holes. When dry, they are mopped with roofing paint or paste. When confronted with badly cracked skylight glass, where it is desirable that we do not disturb the full skylight and run the risk of breaking more panes or possibly having to renew and reset all of them (unless they are too badly broken), we can make them tight by using a large lettering brush to paint a half-inch line of ordinary bridge paint over each crack. We also hunt out all open fine holes and paste them with roof cement or paste, and putty the seams.

Slate has all too often been put on a roof with too flat a pitch. If it does not have plenty of pitch it is troublesome and expensive to maintain. Freezing and thawing break the slate. When such a roof has become so bad as to warrant reroofing it may often be carried over more cheaply for another year by adding sheets or strips of tin or galvanized iron, than by removing the broken slate with slater's tools and renewing patches with new slate. Workmen must be very careful on a slate roof, for if they are not experienced and do not use the proper scaffold and do not take great care they may easily do great damage to a roof, especially where the slate is old. Any number of roof paints on the market, mostly of coal-tar base, can be purchased at very little cost. Roofing paste or cement, or a combination of tar and pitch, can also be had cheaply. Melted and mixed on the job, nearly all can be used even in winter.

Why Some Roadbeds Hold Water and How to Get Rid of It

A. R. E. A. committee discusses soils and their classification and methods of removing the subsurface water from the roadbed under various conditions



Installing a Lateral Drain

THE subject of subsurface drainage is one regarding which there has been a dearth of authentic information despite the fact that maintenance of way officers are confronted almost daily with problems concerning the proper drainage of the roadbed. With this situation in mind, the Committee on Roadway of the American Railway Engineering Association, through a subcommittee headed by G. S. Fanning, chief engineer of the Erie, prepared a report on the subject which was presented at the recent convention of the association at Chicago. The report, which was adopted for publication in the Manual, is abstracted below.

Subsurface drainage may be defined as the control and removal of excess moisture contained in the soil. Such moisture, when present in the roadbed, is detrimental in four respects: (a) It greatly reduces the bearing power of soils of all kinds, some more than others, resulting in soft spots; (b) under freezing conditions it causes heaving of the track; (c) in the event of an increase or a decrease in the amount of excess moisture, unequal swelling or shrinkage results in the displacement of the track; and (d) it often leads to subsidence and slides.

The moisture of the soil is of two kinds—gravitational and capillary. Gravitational water is free to move under the influence of gravity, and can be removed by ditches, drain pipes or other means. Capillary moisture, on the other hand, is tenaciously retained in soils through which free water has passed or which are in contact with wetter soils, by the attraction between the soil particles and the water and the surface tension of the water. Evaporation is the only agency that will remove water from such soils and it may be only partially successful, even after connection with outside sources of water has been removed. It cannot be removed directly by drainage, but can be controlled somewhat by lowering the water table. The amount of capillary moisture that can exist in a soil depends upon the shape, size and mineralogical composition of the soil particles; the greater the proportion of surface area of the particles to the total mass and the greater the percentage of clay, the greater the amount of capillary water.

Drainage problems are definitely related to the mineralogical compositon of the materal involved, the physical condition of the mineral material, and the local geological and climatic conditions which determine the source, or sources, of water. The United States Bureau of Soils has classified soils according to their composition as indicated graphically in the tri-axial soil classification chart and tabulations shown herewith. The adverse character of a roadbed soil depends on (1) its volume change with variations in moisture content or under frost action, (2) its plasticity, that is, its tendency to flow under load, which affects its bearing power, and (3) its tendency to flow because of its content of rounded sand and silt particles. The track may be displaced as a result of any one of these conditions. The Kaolinite group and other micaceous-like minerals, which are important constituents of clays, affect the moisture content of a mass and its plastic properties in proportion to the extent to which they have been broken up into thin plates along the cleavage planes. So far as the stability of the mass is concerned, the term "sand," unless qualified, is misleading. Wet or dry, highly rounded sand and siliceous silts behave very differently from angular sand and silt. The adverse character of a soil, as affected by the presence of water and manifested by vertical swelling, increases with the clay content.

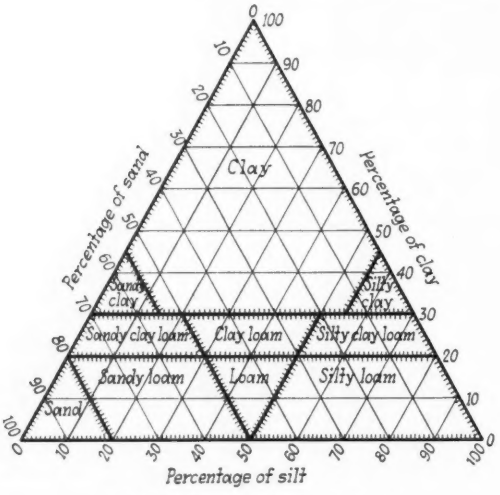
Field Tests for Soils

The clay content of a soil is indicated and the soil identified as good, doubtful or poor for use in a railroad roadbed by a simple and practical field test, known as the "field moisture equivalent" test. The field moisture equivalent is the amount of water, expressed as a percentage of the dry weight of the soil, which it will absorb because of surface tension and adhesion (capillary water). It has been found that generally within the critical limits the "field moisture equivalent" varies directly with the linear expansion of the material due to the absorption of water. It can be determined by the following method.

Use a small tinned iron pan, say 2 in. by 6 in. by 1 in. deep, with many perforations in the bottom. Cover the bottom with thin blotting paper and, after weighing the vessel thus prepared, fill it with the material to be tested which has been thoroughly dried and powdered. In order to allow for possible swelling of the material it should fill the pan not quite to the top after being compacted by shaking gently. After weighing the vessel again set it on a support in a wide pan of water so that the surface

of the water just covers the blotting paper. Within half an hour or two absorption will be approximately complete and if the pan is allowed to remain on the water over night it will be entirely complete. Finally, weigh the pan and its contents to determine the amount of water absorbed by the soil.

If the water content of the soil is divided by the dry weight of the soil and the result multiplied by 100, a value representing the field moisture equivalent is obtained. This percentage can be determined accurately for soils if it is 20 or greater. Soils with values lower



A Tri-Axial Soil Classification Chart

than 20 are so coarse grained as to drain readily and therefore are practically always good subgrade soils. The field moisture equivalents of a large number of soils within the critical limits have been observed to be numerically equal to the clay contents of the soils, expressed in percentages as determined by mechanical analyses. The field moisture equivalent may be assumed, therefore, to indicate the percentage of clay content, eliminating

Classification of Soils

Class of Soil	Per Cent Sand	Per Cent Silt	Per Cent Clay
Sand	80-100	0-20	0-20
Sandy loam	50-80	0-50	0-20
Loam	30-50	30-50	0-20
Silty Loam	0-50	50-100	0-20
Sandy clay loam	50-80	0-30	20-30
Clay loam	20-50	20-50	20-30
Silty clay loam	0-30	50-80	20-30
Sandy clay	55-70	0-15	30-45
Silty clay	0-15	55-70	30-45
Clay	0-55	0-55	30-100

the necessity for the more difficult mechanical analysis. The use of the field moisture equivalent as a means of indicating the clay content and the desirability of soils for subgrade use is not claimed to be positive under all conditions, but it is significant in nearly all cases.

Generally speaking, soils with less than 20 per cent clay, i. e., sands, sandy loams, loams and silty loams (see accompanying tabulation) are considered to be good subgrade soils; soils with 20 to 30 per cent clay, including sandy clay loams, clay loams and silty clay loams, also sandy clays and silty clays are known as doubtful subgrade soils, while clays are considered as poor material for this purpose. Reconnaissance soil surveys may be made by the use of a U. S. Bureau of Soils map in connection with the tri-axial soil classification chart without the use of tests.

The drainage condition of a subgrade soil as well as its bearing power are poor when the actual moisture content of the soil exceeds its field moisture equivalent. Drainage in a broad sense involves both constant elimination of excess gravity water, and the prevention of the access of water to the mass under consideration. In the latter problem it is necessary to deal with lateral seepage or subsurface flow (in volume), vertical or lateral capillary action and direct access of water from rainfall.

Capillary water from below may be excluded by a layer of gravel or broken stone eight to ten inches in thickness. Laterally, it may be intercepted either by ditches or by gravel-back-filled trenches, which also may be used to intercept free water moving laterally. Cut-offs at right angles to the track and extending beneath the ballast are often necessary and on down grades they will eliminate the necessity of considerable drainage of

Size of Soil Particles

Grade	Millimeters
Coarse material	more than 2
Fine gravel	2 to 1
Coarse sand	1 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.1
Very fine sand	0.1 to 0.05
Silt	0.05 to 0.005
Clay	0.005 to 0.0

soft spots. Sometimes necessary support of the roadbed is removed by the movement of the ground away from a positon below and near the roadbed, while in a cut such ground may threaten to overwhelm the roadbed from above. In either case it may be necessary to prevent the absorption of rainfall by oiling such surfaces.

Drainage of Open and Impervious Soils

If the actual moisture content of an open soil (less than 20 per cent clay) exceeds its field moisture equivalent, it is an indication that the soil lies below the water table in a stratum bearing free water. Where this is due to surrounding or underlying impervious strata, the water table may be lowered by one of three methods as follows:

(a) By an outlet through the surrounding material.
(b) By drilling through the impervious bottom of the area to permit the water to escape through lower pervious strata, if such strata exist.
(c) By placing sub-drainage pipe at such a depth as to lower the water table below the level of adverse effect. With this method an outlet is essential.

If the actual moisture content of a less pervious soil (more than 20 per cent clay) exceeds its field moisture equivalent, there is also free water present which should be removed by subdrainage. The lowering of the water table in such soils also tends to decrease the amount of capillary moisture near the subgrade surface. Some of the denser clays are so impervious as entirely to prevent the passage of free water through them and in such soils drain pipes are of no value. It is preferable to keep the water away from such soils in the first place, as they retain extremely high percentages of capillary water.

Pipe Drains

Except in impervious soils, the efficient subdrainage of wet cuts and of saturated soil upon which embankments rest may be attained by the use of pipe drains. In cuts the main pipes should be laid parallel to and nine feet from the center line of the adjacent track. Along embankments the location should be about ten feet from the toe of the slope, thus keeping the pipe away from

the zone of subsidence under the fill and outside of the deposit of sediment washed down the slope. The grade of the pipe should not be less than 0.2 per cent and preferably 0.4 per cent or greater where practicable. Where possible, mains should be laid on a uniform grade or with the grade increasing towards the outlet; where a reduction in grade is unavoidable, an adequate catch-basin should be provided.

The depth of the pipe may depend wholly on the level of the water source. A minimum depth of three feet below the bottom of the ditch or six feet below the subgrade in cuts or six feet below the natural ground surface along fills is recommended. Care should be taken to locate the pipe at such depths that no displacement will be made in the alinement or grade of the pipe by the subsidence of the roadway under traffic or by the action of frost. To this end the trench in which the pipe is to be laid should be dug down into a motionless stratum underlying the saturated material which it is desired to drain. Where this is impracticable some means of curing the situation other than by the installation of drainage pipe must be adopted.

The minimum inside diameter of pipe for main drains should be six inches. In long wet cuts the diameter of the pipe should be increased at intervals between the source and the outlet as the increasing flow demands, from 6 in. to 8 in. to 10 in. to 12 in., etc., as necessary.

In extremely wet cuts, the mains alone may not be sufficient and laterals extending under the track may be required. These should be spaced from 10 to 40 ft. apart, depending upon the character of the material to be drained. A minimum grade of four per cent and preferably eight per cent (1 in 12) should be provided to prevent sedimentation. The maximum grade should be 16 per cent (2 in 12), as with greater grades there is danger of the lateral being forced into the main.

The pipe used should (1) have ample strength to sustain safely the load and impact to be imposed upon it, (2) provide initially and maintain continually a high capacity for drainage, unimpaired by the separation of its units or by the admission of soil or rock particles, and (3) have sufficient durability to insure a long service life with a resulting economy and freedom from interference with train operation because of renewals.

Kinds of Pipe

Two materials are available, each of which, if properly laid, fulfills these conditions. These are No. 1 vitrified clay sewer pipe with bell ends, and corrugated galvanized iron pipe with ¼-in. perforations in the valleys of the corrugations (where the pipe diameter is least) and spaced 1½ in. apart for 120 deg. of the circumference.

The question as to which of these to use will depend on local conditions and on the relative costs. Vitrified clay pipe will usually cost less than corrugated iron pipe and is preferable where the excavation is of any considerable depth into firm material or where the water carries sulphur or other chemicals in quantities injurious to iron pipe. Corrugated iron pipe is preferable where the cover is shallow or the material is unconsolidated and where vitrified pipe might be subject to breakage or its alinement disturbed by accident or heaving.

The cross-section of the trench should be such as to prevent the permeable backfilling from being cut off through the temporary heaving of the roadbed before it becomes compacted through drainage. A bottom width of 18 to 30 in. is recommended, with the side opposite the track vertical and the side near the track vertical to an elevation such that a slope excavated at an angle of 45-deg. will intersect the bottoms of the ties at their ends. The trench should be excavated to a depth of from two to four inches below the grade established for the outside surface of the bottom of the pipe. The soil removed from the trench should not be used for the pipe covering nor even deposited in the vicinity, but should be hauled away from the site at the time it is excavated. The bottom of the trench should be backfilled thinly with a selected permeable material to provide a firm surface at the correct grade as a foundation for the pipe.

Installation of Pipe

Commencing at the lower end, tile pipe should be laid with the bell end up grade, leaving the joints open to permit the water to enter. Corrugated iron pipe, which may be obtained in lengths in multiples of 2 ft. up to 20 or 30 ft, should normally be laid with the perforations in the bottom with the inside circumferential laps pointing down stream. Laying the pipe with perforations down permits the greatest inflow of ground water with the least intrusion of sediment.

With either type of pipe, deep open-ditch outlets should be avoided by extending the pipe to shallow cover but not into the frost zone. The outlet ditch should be excavated well below the outlet on a heavy grade. The pipe outlet should be protected by a screen to prevent the entrance of animals into the pipe.

Installing a Drain Where Drainage is Badly Needed

Risers should be placed at the upper end of each main and at intervals of 300 ft. along the main to permit of flushing. The entire trench should be backfilled carefully with a selected permeable material, such as clean crushed stone or washed gravel. Engine cinders should be used only when no other satisfactory material is available, but never with corrugated iron pipe on account of the corroding effect of the sulphuric acid which is present.

On new construction the drainage system should be completed before any track work is undertaken, if it is possible to get the pipe and backfill material to the work. A complete record should be kept of all drains, which should include a description of the kind, size, location and depth, so that they may be located easily when necessary. A yearly inspection should be made on all subdrainage systems to assure proper maintenance.

What's the Answer?

Have you a question you would like to have someone answer?

Can you answer any of the questions listed in the box?

Motor Cars as Work Trains

To what extent is it practicable to substitute motor cars and trailers for work trains for section work? For extra gangs ?

They Are Used Extensively

By C. H. ORDAS

Supervisor of Motor Cars, Chicago, Milwaukee, St. Paul & Pacific, Chicago

In general, the extent to which section motor cars and trailers can be substituted for work trains to transport men and materials, depends on the power developed by the engine, the capacity of the cars and trailers, the magnitude of the grades and the character of the work to be performed. We use section cars extensively for distributing cross ties, crossing planks, drain pipes, spikes, bolts and other classes of materials, which are set out on station sidings in carload lots by revenue trains.

Through the use of heavy-duty motor cars, trailers and push cars we have also been able to effect large savings in work train service for bridge and building gangs and extra gangs engaged in track maintenance. This is particularly true with respect to the transportation of men in large gangs between camps and the site of their work. We have found the motor car and trailer equally effective and economical for distributing track fastenings, bridge timbers, culvert pipe and other materials which these gangs require.

Marked Reduction in Work Train-Miles

By C. R. KNOWLES

Superintendent Water Service, Illinois Central, Chicago

It is rather difficult to state definitely the extent to which motor cars and trailers may be substituted for work trains, although it is a well-known fact that the motor car has become an important factor in reducing the number of work trains required. Statistics show that for the five-year period ending in 1927, there was an average annual reduction of 11,549,000 work train-miles, as compared with the five-year period from 1911 to 1915. While other factors, obviously, entered into the reduction in work train-miles, motor cars were an important factor.

Motor cars and trailers are of particular advantage for extra gangs, and in many instances entirely eliminate the work train except for the distribution of ballast and rail. The motor car not only saves much of the work train cost but also effects material economies in the amount of time saved in the reduction of unproductive travel time where gangs are moved by motor cars instead of work trains.

Motor cars and trailers are used extensively in ordinary section work and as with extra gangs, replace the work train in many instances, although the saving in work train cost resulting from the use of motor cars in section service may not be as great as in extra gang service, for the reason that fewer men are involved.

The size, weight and pulling power of cars used in ordinary section work are limited to a certain extent by reason of the fact that the cars must be light enough to be readily removed from the track by a few men. As a result, their capacity for handling trailers is somewhat limited, while with an extra gang a heavy-duty car capable of hauling almost any kind of a load on ordinary grades can be used. Even with the limitations placed on the ordinary section car, it will readily handle two trailers carrying 25 to 30 men and 50 to 60 ties.

To Be Answered in November

1. When inspecting ties, what details are to be noted as indicating that a tie should be renewed the following season? Who should make the inspection? Should it be checked? If so, by whom?

2. When removing awnings and door and window screens from offices, stations and other buildings and storing them for winter, what provisions should be made to insure that they will be in condition for use the following season? By whom should this be done and where should they be stored?

3. What is the most satisfactory width of cutting edge for hand adzes?

4. What is the most satisfactory method of maintaining line on a pile or timber trestle?

5. What is the relative importance of line, surface and gage in maintaining smooth-riding track? Why?

6. Under what conditions should underground pipe lines be protected against corrosion? What means can be employed?

7. Where mile numbering is placed on telegraph or other pole lines, what is the most practicable and economical method of placing the numbers on creosoted poles?

8. Under what conditions, if any, and to what extent is it desirable to provide concrete footings for concrete crib walls?

Possibilities Are Not Developed

By Division Engineer

Owing to the relatively short interval that has elapsed since the motor car came into general use and because of its rapid development, even a guess as to its ultimate possibilities would be hazardous. It was conceived originally as a means of facilitating track and bridge and building inspection. Later, its economy in the transportation of men to and from their work was realized. As its power plant was increased, it was found to be effective in connection with trailers in the distribution of materials, until at present it is used widely for this purpose.

While the motor car in its present form cannot be expected to be a substitute for all work-train service, it is already reducing the number of work trains required in track and roadway maintenance on many roads, for example, in the oiling of rail joints or the rail and fastenings; in the application of various types of weed destroyers; in the distribution of many classes of material; in the transportation of large gangs to and from work, often for considerable distances; and in handling large inspection parties.

In recent years the cost of work-train service has increased out of proportion to its value in the transportation of men or of relatively small quantities of material. For this reason, maintenance officers have by force of circumstance been compelled to find other means of meeting their needs, and have turned to the motor car as both effective and economical for these purposes. I think it is safe to predict that, as its possibilities in these applications become more appreciated, the motor car will be used more and more as a substitute for work-train service, and that new uses not now thought of will become common practice. I cannot conceive that the development of so useful a machine will not go forward in the future as in the past.

Centrifugal or Reciprocating Pumps

What are the relative advantages of centrifugal and reciprocating pumps for pressure pumping? What are the limitations ?

Centrifugal Pump Is More Satisfactory

By E. M. GRIME

Engineer Water Service, Northern Pacific, St. Paul, Minn.

For numerous reasons centrifugal pumps have been growing in favor for railway water supply, particularly in the last decade. These pumps lend themselves readily to automatic electric operation; they permit the use of motors of minimum size, since the starting torque is low and increases gradually to normal at normal speeds; while the floor space required for their installation is much less than for reciprocating pumps of the same capacity.

If the discharge is closed, the water churns and the torque for normal speed remains well below that for full load, thus eliminating the probability of damage to the equipment. In many cases motor-driven centrifugal units cost little if any more than 10 per cent of the cost of reciprocating pumps of the same capacity and overall efficiency.

The design of the casing and impellers can be varied to fit almost any set of conditions, from loose-fitting impellers suitable for pumping sewage and other coarse materials, even including brickbats, to impellers for clear water which have but a few thousandths of an inch of clearance and an overall pump-motor efficiency of 73 to 80 per cent. A centrifugal pump will have a maximum efficiency for only one set of conditions, but can be designed to have a wide range of action with little decrease in overall efficiency, even at the limits of this range. For these reasons, centrifugal pumps are suitable for situations where there are relatively wide variations in the discharge head.

Possibly the most serious disadvantage of the centrifugal pump is that it requires a comparatively low suction head and no air leaks can be permitted in the suction. While it will operate on higher lifts, the suction lift should not exceed 11 to 13 ft.; otherwise there is a loss in efficiency. This compares with lifts of twice this amount which are common for reciprocating pumps.

Owing to its higher first cost, it is difficult to find advantages in the reciprocating pump for ordinary railway installations. This type is not suited for handling water containing sand or grit. Unless the cylinder packing is kept loose enough to permit excessive leakage, gritty material will soon wear the pistons to the extent that the packing becomes ineffective. Again, the pressure in the cylinders is raised from zero to the maximum during every stroke, thus transmitting the pulsations to the discharge line and tending to cause water hammer.

Another disadvantage of this type, especially if motor-driven, is the high starting torque, a result of the positive displacement of the pistons and the sliding friction of the reciprocating parts. Owing to the tight fit of the various parts, this may be as much as 25 per cent or more above normal. A bypass is sometimes placed between the suction and the discharge to decrease the starting torque, but this is objectionable, especially at small stations where the demand seldom justifies the employment of experienced help.

Modern railway practice is such that centrifugal pumps are the most satisfactory type for about 99 per cent of the usual installations, the exception being those cases where the water engine is used for metering or for chemical proportioning and mixing.

Advantages Favor Centrifugal Type

By W. H. ARMSTRONG

Ingersoll-Rand Company, New York

While the reciprocating pump is somewhat higher in efficiency, the centrifugal pump requires much less space to handle the same volume of water against the same head; it is also lighter in weight and costs appreciably less. On the other hand, the reciprocating pump is self-priming, while the centrifugal type requires provision for priming.

Centrifugal pumps give a smooth, even performance which provides a continuous non-pulsating flow. In contrast, owing to the reversal and varying speeds of the piston, every stroke of a reciprocating pump causes a surge in the discharge line, requiring external means, such as surge tanks or air chambers, to minimize this unfavorable feature.

Provided the parts are strong enough, a reciprocating pump will handle its rated capacity against any head. For this reason, on the crank and flywheel type of power pump, the driving motor may easily be overloaded. The characteristics of centrifugal pumps are such that the maximum horsepower that a pump will require under any circumstances can be determined and the power unit so chosen as not to become overloaded.

In multi-stage centrifugal pumps of the balancing-drum construction, the packing is subject to a pressure

of only a few pounds above that of suction. In reciprocating pumps, however, the packing is subject to the maximum pressure of discharge, although friction due to high relative speeds is less.

Relative speeds between moving and stationary parts are much greater in centrifugal than in reciprocating pumps. For this reason, the parts wear more rapidly in the former type, although the wearing parts are all easily renewable. In the latter type, the wearing parts are not easily renewable, so that efficiency, once lost, cannot be regained.

In general, the maintenance costs for centrifugal pumps are lower, owing to the fact that the maximum stresses that will be applied can be easily determined and the parts designed to resist them. Owing to the possibility of unexpected increases in the pressure and the consequent danger of overload, the breakage of reciprocating-pump parts becomes a definite factor in maintenance costs. Furthermore, the wear on valves, etc., which are not part of a centrifugal pump assembly, adds to the cost of maintaining reciprocating pumps.

Ballast for Sidings

What type of ballast is most suitable for passing and other frequently used sidings? What should be the minimum depth of the ballast under the ties ?

Pit-Run Gravel or Cinders Makes Good Ballast

By E. H. PIPER

District Engineer Maintenance of Way, Chicago, Burlington & Quincy, Lincoln, Neb.

In general, the most suitable ballast for passing and other frequently-used sidings is a material which will afford proper drainage and support for the track, but which can be obtained at lowest cost. Ballast suitable from an economic standpoint for use in sidings is generally unsatisfactory for main-line use. This is not always true, however, for in many instances pit-run gravel similar to that in service in main tracks may be used, the cost per cubic yard being nominal.

Locomotive cinders are used extensively on many roads for ballasting passing and other frequently-used sidings. Usually the so-called pit cinders are considerably softer and have a much finer aggregate than cinders made at commercial plants. Locomotive cinders accumulating at cinder pits must be disposed of in some manner. For this reason, they provide an economical material for use as ballast on the less-important branch lines or for sidings and other secondary tracks. Since they must be disposed of in any case, about the only cost involved in this application is that of transportation.

If the aggregate is at all uniform and not too large, pit-run gravel makes an excellent and economical material for ballasting tracks of the types under consideration. Where it can be loaded by company equipment, pit-run gravel can be handled so that it, too, is an economical ballast material, about the only costs involved being those for loading and transportation.

The minimum depth of both cinder and gravel ballast should be four inches. The determining factor, however, is the subgrade. If it is of such a character that it has a tendency to become soft after a heavy rainfall, the necessity for drainage may require a greater depth of ballast. Soft cinders tend to compact to a greater extent than gravel and other materials that are sometimes used as ballast, so that the application of this minimum may result ultimately in very little material under the ties. Four inches of soft cinders will, in a short time under ordinary use, be reduced to two inches or less, and certainly this is not too much. For this reason, I am of the opinion that a depth of six inches at the time of application is economical and entirely justifiable.

Stone Screenings Make Best Ballast

By J. W. CUMBY

Section Foreman, Norfolk & Western, Blackstone, Va.

It is my experience that coarse screenings from stone ballast provide the best material for ballasting passing or other frequently-used sidings. This is particularly true in the case of passing sidings where the main tracks are ballasted with crushed stone. This material affords excellent drainage, holds the surface and line well, keeps down vegetation and presents a pleasing appearance when neatly dressed. In my opinion, the minimum depth under the ties should be from 6 to 8 in.

Sidings Are Often Neglected

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

This is an excellent question to bring before maintenance officers, particularly as there is often a marked tendency on the part of local officers and the section forces to slight this important part of their work. Relatively few passing or other sidings have high-speed movements over them, and for this reason it is not necessary to maintain them to main-line standards. As a result, while I do not wish to imply that they are unsafe for any of the uses to which they are put, in many instances they are not as well maintained as the standards of the railway will justify. A siding along the main line, which is not properly filled, with an undressed shoulder and an irregular ballast toe line, indicates poor housekeeping on the part of those responsible and offers a poor advertisement for neatness, no matter how well-kept the main tracks may be.

I know of no ballast material superior to locomotive cinders for passing sidings and other secondary tracks. If the track is properly filled and dressed, it presents a neat appearance. Cinders retard the growth of vegetation and thus reduce the work of the section forces; their cost is practically that of transportation, so they are economical; they are easy to work, resulting in a low labor cost for surfacing and tie renewals.

Stone screenings from ballast manufacturing operations can often be used to advantage. They are relatively easy to handle in application, as well as when surfacing and renewing ties. When clean, they retard the growth of weeds, and when properly dressed, they present a neat and pleasing appearance. On the other hand, sand or gravel are less satisfactory materials. They are more difficult to work, track cannot be kept in surface as easily and vegetation grows more readily in them. If the gravel is coarse, it may require the application of finer material to act as a binder. Sand often requires a covering of cinders to keep it from blowing away.

There should be ample ballast under the ties to prevent mud from working up through it and to keep the track "alive". This depth will depend on the character of the subgrade, the type of ballast and the provisions for drainage. It is difficult, therefore, to set an absolute minimum, because a depth of ballast that might be entirely satisfactory under one set of conditions might be inadequate under another. In general, and this is particularly true of passing sidings, sidings should not be

raised to the level of the main track, but should be kept at least six inches lower. This not only facilitates drainage of the main track, but presents a better appearance.

In any event, as a general proposition, we should have more and better ballast on our sidings. They should also be given more attention in the matter of surfacing as well as in dressing the ballast and in maintaining a ballast line.

Prefers Locomotive Cinders

By HENRY BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

Locomotive cinders are suitable for ballasting passing and other frequently-used sidings and, so far as my own experience goes, I do not know of any material that is superior. They are easily handled when making the original application, and can be worked easily and rapidly when surfacing or renewing ties. They afford excellent drainage, discourage the growth of vegetation and hold the line and surface well under any traffic that is likely to be served by the tracks under discussion. Being a waste product, there is no cost except that of transportation, so they are economical in first cost as well as in the upkeep of the tracks.

I would not use less than 4 to 6 in. under the ties, and in many instances this depth should be increased. However, as they "wear out", a light application, say 2 or 3 in., will serve the same purposes as a heavier application. They are easily dressed. If this is done and the few weeds that will persist in growing are eradicated, the sidings will present a neat and pleasing appearance.

Foundations for Culvert Pipe

When placing a culvert pipe for a new embankment or to permit the filling of a bridge, how should the foundation be prepared ?

A Smooth, Even Bearing Is Essential

By Engineer Maintenance of Way

A smooth even bearing is essential for a pipe culvert under fills of any height if it is to remain in correct vertical and horizontal alinement. If conditions permit, it is preferable to lay the pipe in a narrow trench, the bottom of which conforms with the perimeter of the lower part of the pipe. After the pipe is in place, the trench should be back-filled and the material thoroughly compacted on the sides to offer maximum resistance to horizontal distortion of the pipe section.

If a trench is not practicable, a cover should be built up in thin horizontal layers which are thoroughly compacted for the same purpose. This cover should extend over the top of the pipe to the same thickness as on the sides. This thickness will depend on the depth of the fill, the character of the material of which it is to be composed and the manner of placing.

A soft yielding foundation calls for different treatment. In some cases a timber grillage to support the pipe may be sufficient. Where the conditions are more severe and the cost of a concrete culvert cannot be justified, a pile foundation to support a timber grillage or reinforced concrete mattress may be required. In this event an ample cushion of well-compacted earth should be interposed between the pipe and its support. In any event, similar precautions should be taken to insure resistance to the forces which tend to increase the horizontal diameter. Under exceptionally high fills or where embankments are constructed of rock, this may require the application of vertical struts in the culvert until the embankment is well settled.

Should Avoid Possibility of Movement

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

When a new embankment is constructed or a bridge filled, the new material usually has considerable movement before it reaches its final settlement. For this reason, if the pipe is not well placed to resist movement, it will be distorted and in many cases will collapse so that the failure will be complete. When placing a pipe culvert under the assumed conditions, if the flow line will permit, the excavation should be made to conform to the perimeter of the lower half of the pipe. If this is not practicable, filling material should be placed in relatively thin layers, tamped to shape and for a distance of not less than one diameter on each side. This filling and tamping should be continued over the top.

Extra precautions should be taken to see that all stones, logs, stumps and pile stubs are removed to a depth sufficient to insure that they will not eventually come in contact with the pipe. When the weight of the new fill comes on the pipe, such hard materials may do irreparable damage if they are left to contact with the pipe.

If necessary to install two or more lines of pipe, each line should be separated from the adjacent one not less than one diameter, and, the filling and tamping should be the same for each as for a single line. If the filling is to be done by train, and particularly if the drop is considerable, or if heavy tractors and wagons are employed, the placing of the cover of earth and the tamping should extend farther than a single diameter in each direction from the pipe.

Treated Lumber in Buildings

To what extent is it practicable to use treated lumber in railway buildings ?

Can Be Used More Generally Than Is Done

By Building Inspector

Both experience and observation indicate that the use of treated lumber in building construction is practicable to a much greater extent than is present practice. Creosoted material is suitable for sills and floor joints, for the underpinning of frame buildings which are not supported on masonry piers or foundations and, sometimes, for subfloors. It can also be used for the posts, beams, joists and bracing of wooden platforms. Under some conditions it can be used in the roof members and as sheathing in frame and semi-permanent buildings. I have in mind a number of enginehouses in which all wooden members, including those in the roof, are of creosoted material.

Creosoted lumber is not suitable for wall studding, for flooring or for decking platforms over which it is necessary to handle sugar, cotton, flour and other commodities which may be damaged by the exuding preservative. Its use is somewhat doubtful for decking passenger platforms, although I have seen it used for this purpose. Obviously it cannot be used for siding or for any parts which must be painted.

On the other hand, there are several preservative salts, the most notable of which are zinc chloride and zinc-meta-arsenite, which can be used to advantage to treat wall joists, siding, platform decking and exposed members which require painting. Many tests have been made which are said to indicate that lumber treated with these preservatives can be painted with the same facility as untreated material.

One feature should not be overlooked in considering the probable advantages of the use of treated lumber in buildings. Evidence is plentiful that the menace of termites is increasing in many sections of the country, and that the infestation is gradually extending to places where they have not been known heretofore. While certain precautions can be taken to reduce the probability of damage, the only insurance of absolute safety, so far as present knowledge goes, is in the use of creosoted material for wooden structures or wood members in brick or concrete buildings. While it is obviously out of the question to use creosoted material for every wooden member of many classes of buildings, treatment with one of the salts mentioned offers the next best assurance of immunity.

All lumber to be treated, regardless of the preservative used, should be framed before it is treated. This is done for bridges on a number of roads. It should not be more difficult to do so for building material. Possibly, however, greater care may be necessary in the case of certain building members to insure accuracy of fit.

Lumber Should Be Preframed

By FRANK R. JUDD

Engineer of Buildings, Illinois Central, Chicago

It is practicable to use treated lumber in those portions of permanent railway buildings which are exposed to alternate wetting and drying processes, unusual dampness, lack of ventilation and the attacks of destructive insects. In the typical building this includes all wood parts to the underside of the flooring. Frame structures which are supported on posts should have treated material for the posts, the mud sills, the girders, joists, etc. For first-class brick buildings which require support other than that afforded directly by the bearing power of the soil, treated piling should be used.

Exterior wooden platforms which are intended to be permanent, especially where exposed to adverse ground and weather conditions, should have all parts of treated material.

Wherever it is practicable, it is desirable to do the necessary framing of the material in advance of treatment. If this is not done, and the framing is done in the field after treatment, it is quite likely that untreated wood will be exposed in the process. In this event, all exposed surfaces should be carefully dipped into or coated with some form of preservative to provide as much protection as can be given under the circumstances.

Depends Largely on Character of Structure

By J. J. LA BAT

Assistant Bridge and Building Foreman, Missouri Pacific, Wynne, Ark.

While it is entirely practicable to use treated lumber for many purposes in railway buildings, the extent of this use will depend largely on the type of structure, the use to which it is to be put, its location and the general conditions surrounding it.

From an economic standpoint all sills, floor joists and subfloors should be preframed and treated. As a general rule, if these parts of a structure are untreated they are the first to fail and often they must be renewed several times before the remainder of the building requires more than nominal attention. This is particularly true in the southern states if the under parts of the building are enclosed by foundation walls, as this produces a condition that promotes the work of termites.

It is not practicable to use lumber treated with creosote or creosote mixtures as decking on platforms in those sections where cotton shipments are handled, since this preservative exudes from the wood when exposed to high temperatures and the direct action of the sun during the summer and early fall. It is my experience that it is better to use untreated hardwood for platfrom decking where cotton shipments are made and on other platforms where heavy trucking may be expected.

Back-Filling for Retaining Walls

Should impervious clay or porous materials, such as sand, gravel or locomotive cinders, be used as back-filling next to retaining walls and bridge abutments? Why ?

Locomotive Cinders Should Not Be Used

By Engineer Maintenance of Way

In common with most questions of this character, the answer will depend somewhat on the conditions which surround the structure. In general, however, if the embankment is pervious and is founded on pervious material which will easily absorb the drainage back of the structure, the back-fill may be of any porous material except locomotive cinders. If, on the other hand, the natural soil is impervious or will care for the drainage slowly, then openings in the form of weep holes through the wall or special provision for collecting and leading the drainage to a sewer should be provided. In either case, it is desirable to back-fill with porous material to insure quick disposition of the water.

Any condition which permits the collection and retention of water back of a retaining wall or abutment is undesirable, and in some instances may be disastrous. Water which may be impounded in this way is almost certain to find its way through the wall or abutment eventually. The least damage that may be expected is disfigurement of the exposed face. At the other extreme there may be severe disintegration of the masonry as a result of continued cycles of freezing and thawing. Again a reservoir of water held behind a retaining wall or high abutment may develop horizontal pressures of greater magnitude than could have been foreseen by the designer, with the result that its stability is threatened. For the reasons set forth, whatever class of material is employed for the purpose of back-filling these structures, care should be exercised to insure that ample provision is made for either natural or artificial drainage which will eliminate any probability of the collection and retention of water.

Locomotive cinders should never be used as back-filling for either abutments or retaining walls, because of the facility with which they catch fire. Not infrequently fires start deep in a mass of cinders and burn for days before there are any surface indications of their presence. I recall a case in connection with an abutment and high retaining wall on a track-elevation project. In violation of instructions, a supervisor used cinders for the back-fill at one of the streets. Several weeks later it was discovered that the wall was damaged, and that the ex-

posed face was very hot. Further investigation disclosed a deep and extensive fire in the back-filling, although there was little surface indication of its presence. The ultimate result was that the abutment and part of the wall were badly damaged; in fact, several sections of the latter were injured to the extent that it was necessary to remove them. Both the wall and the abutment had been waterproofed and draining had been provided. The waterproofing was entirely destroyed and the drainage system was disrupted, so that the former had to be replaced and the latter restored. As a result of this experience I have never permitted locomotive cinders to be used as back-filling for any masonry structure.

Drainage Must Be Provided

By Engineer of Design

Any material that is suitable for the construction of an embankment may be placed back of an abutment or a retaining wall, provided that its use will not result in the entrapping of appreciable quantities of water in that material. There are two reasons for this: (1) The development of any considerable hydrostatic pressure behind the wall will result in seepage of water through the masonry and this is sure to result in disintegration sooner or later. (2) The hydrostatic pressure developed in some cases may exceed the lateral pressure for which the wall was designed and produce excessive overturning moments. The designer has a right to expect that the filling material and the manner of its placing are such that no more than normal lateral earth pressures will be developed. To provide for greater pressures under usual conditions would involve unnecessary extravagance.

If the fill is constructed of pervious material and is supported on natural ground that is also pervious, ample natural drainage is ordinarily assured. A fill of pervious material on an impervious support, if the embankment is not too wide, will in most cases be self draining, but in general, provision for drainage must be given careful consideration. The safest course is to provide weep holes, drain pipes, etc., suitable placed to insure the release of entrained water, and, to make such measures effective, the wall should be backed with at least a blanket of pervious material to enable the water to reach the drains.

Burning Weeds

What means, if any, should be employed to eliminate the possibility of damage to ties when operating weed burners ?

Only Old Ties Are Damaged

By J. MORGAN

Supervisor, Central of Georgia, Leeds, Ala.

The answer to this question depends largely on local conditions, including the character and density of the vegetation, the character of the flame produced by the burner, the facility with which the flame can be controlled and the condition of the ties. If the operator is skillful, he will not overfeed the flame. Too much oil delivered at the burner will allow blazing but unconsumed oil to fall on the ties, with the probability that they will be set on fire.

In the operation of weed burners I always insist on a rate of oil delivery which insures a bright hot flame in which all of the oil is consumed. This type of flame will not damage sound ties, provided the burner car is operated at the proper speed. It is obvious, however, that if a low speed is maintained and the flame is allowed to remain over the ties for a considerable time, the danger of igniting them is greatly increased.

If any of the ties are old and partly decayed on top or are badly checked and splintered, unusual care must be exercised, since they are easily ignited and usually burn persistently. On the other hand, fires in sound ties that are ignited but not drenched with burning oil, even though they may be creosoted, usually die down in a short time without causing any apparent damage.

As a precaution against damage from fire, we are preparing a sprinkling device which is to be propelled by a motor car, and which will carry an ample supply of water to quench fires that may be ignited and continue to burn for any length of time. It is to follow about one-half mile behind the burner, which will allow ample time for most of the fires to burn themselves out naturally, while enabling those fires that persist to be quenched. Heretofore, we have followed the burner car with water barrels on a section motor car, but this is an unhandy arrangement as the barrels must be transferred at the end of every section.

Burning Should Be Done in Two Stages

By J. B. KELLY

General Roadmaster, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.

To insure that ties will not be damaged, weed burners should be required to make two trips over the territory on which the weeds are to be destroyed. On the first run the flame and speed should be so regulated that the vegetation will be well scorched. On the second run the dead vegetation should be burned completely. The intervals between the burnings will necessarily be governed somewhat by the amount of territory which the burner is required to cover and the effectiveness of the first pass. The second burning should be completed, however, before there is any indication of growth in those weeds which were not killed during the first passage.

When an effort is made to accomplish a complete burning in a single passage of the weed burner, a maximum flame and low speed are usually required. While I have never done this, I am of the opinion that heat of the intensity that is necessary to consume a heavy growth of green weeds, which must be applied for an appreciable time, cannot have other than a detrimental effect on the ties, particularly those that are creosoted, which will shorten their service life. This is equally true for slow speeds, whether the weeds are destroyed in one or two passes. If the burners are operated properly, this danger will be reduced to a minimum and there will also be little if any damage to either treated or untreated ties.

Present Burners Seldom Injure Ties

By ROY HAHN

Clerk to Master Carpenter, Seaboard Air Line, Tampa, Fla.

One of the defects of the earlier types of weed burners was the inability to control the delivery of oil to the burners. The result was that the track was often drenched with burning oil and both the ties and the adjacent right of way were set on fire. Again these burner cars were propelled by locomotives which were not always quickly responsive to the speed requirements, with the result that the flame was sometimes held too long over the ties and sometimes not long enough to kill the vegetation. Under these conditions it was necessary for the section gangs to follow behind the weed burners to

quench the ties that were set on fire and to fight the fires that spread to the right of way.

Modern weed burners are susceptible of much closer control of the delivery of oil to the burner and, therefore, of the flame. Since they are generally pulled by a motor car, the speed of operation of the weed burners is also under better control.

For these reasons, an experienced operator is able to regulate the flame and speed according to the character and density of the vegetation, thus conserving fuel and reducing the probability of fire. In fact, unless the operator becomes careless, the danger of fire is quite remote. As a precaution, however, I consider it wise to follow the burner car with a 500-gal. water tank mounted on a push car and equipped with a 1¼-in. or 1½-in. hose. The tank car should also be pulled by a motor car.

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Mixing Ties

Where heavy rail and large tie plates are used, is there any disadvantage in mixing hardwood and softwood ties on tangents? On curves? If so, why ?

[An extended answer to this question will be found in an article by W. J. Burton, which appears on another page under the title, "What Is a Softwood Tie?"—Editor]

Segregation Results in Better Track

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

It is my experience that the mixing of hardwood and softwood ties is a disadvantage on either curves or tangents. By doing so the bearing for the rail lacks uniformity and maintenance costs are higher if first class track is maintained. I have often observed that when the two woods are mixed, the hardwood ties offer a firm bearing while the tie plates cut into the softer ties. This affects the surface and more labor is required to maintain smooth-riding track. Again, this condition may cause surface bending of the rail, and I have found rails broken over softwood ties that offered poor bearing for the rail in the space between hardwood ties. On curves, particularly, softwood ties do not hold the gage as well as the hardwoods, and the latter should be used exclusively. On tangents the two types should be segregated and used in groups for best results.

There Is No Disadvantage on Tangents

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

There is no disadvantage in mixing hardwood and softwood ties on tangents, provided heavy rail and tie plates of ample size and thickness are used. Although it is our custom to use hardwood ties on curves, including white oak, locust and mulberry, we have curves which are laid with mixed ties; however, I prefer all hardwood timber when it can be obtained conveniently. Hardwood ties should also be used through station grounds, in narrow cuts and elsewhere where it is more difficult to maintain the track. On the other hand, it is possible to use softwood and inferior hardwood ties on sidings and in yards and, usually, they can be mixed without detriment to maintenance, although, as on the main tracks, they should be protected with tie plates.

My preference for hardwoods on curves is based on the obvious necessity for selecting the kind of wood that will be most resistant to the special stresses that are imposed on the ties on curves. These stresses result from the tendency of the rail to tip over and the effort of the wheels to spread the rails. On tangents nearly all of the load is applied vertically so that any tie that is able to offer sufficient bearing power under the tie plate is satisfactory. Obviously, any wood that is too soft to provide the required bearing resistance will crush and is, therefore, unfit for tie timber and should not be used alone or mixed with hardwoods.

One word about tie plates: In the past, many designs of tie plates did not have sufficient thickness and bent under the loads that were imposed. While this condition has been very largely corrected in modern designs, the proper thickness as well as base area should be stressed in order to obtain the maximum service from ties.

Thinks It Advantageous to Mix Them

By W. RAMBO

Roadmaster, Missouri Pacific, St. Louis, Mo.

Where rails are heavy and tie plates large, there is no disadvantage in mixing hardwood and softwood ties on tangents. In fact, there is a distinct advantage in doing so where there is a scarcity of hardwood timber. In this event I would select hardwood ties for the joints and softwood for the body of the rail. If only enough hardwood ties are available to take care of the curves I prefer using all softwood ties on tangents, including those for joints. I do not approve of using softwood ties on curves, even where heavy rail and large tie plates are used in connection with them.

Does Not Favor Mixing Them

By J. MORGAN

Supervisor, Central of Georgia, Leeds, Ala.

There is a marked disadvantage in mixing hardwood and softwood ties indiscriminately when track is to be maintained to the highest standard, despite the use of heavier and stiffer rail and tie plates of large area. It is obvious that hardwoods offer greater resistance to the imposed loads than softwoods. For this reason, when the two are mixed on either tangent or curve, it can be observed that after a year or two of service, as trains pass, there is more play between the rail and the softwood ties than on the hardwood ties.

This condition results from two causes: The ballast cuts into the bottom of the tie, permitting more vertical movement of the tie itself, and the plate cuts into the upper face. This is scarcely noticeable at first but becomes plainly evident after several years, and eventually affects the riding qualities of the track. Instead of mixing the two woods indiscriminately, they should be laid so that the hardwood and softwood ties will alternate; or, if the numbers are not equal, they should be mixed uniformly in the proportion that each wood is available. In either event, more uniform track will be obtained than by indiscriminate mixing. Where the standards of maintenance are low, such a separation becomes of minor importance and an indiscriminate mixing may not be objectionable.

A CORRECTION.—Through an error, C. D. Purdon was misquoted with reference to the Eads bridge on page 511 of the August issue. What he said was "Later expansion joints were installed after all attempts at anchoring failed," while the remainder of the first paragraph was not part of his discussion. Mr. Purdon advises that he thinks these joints did correct the trouble.

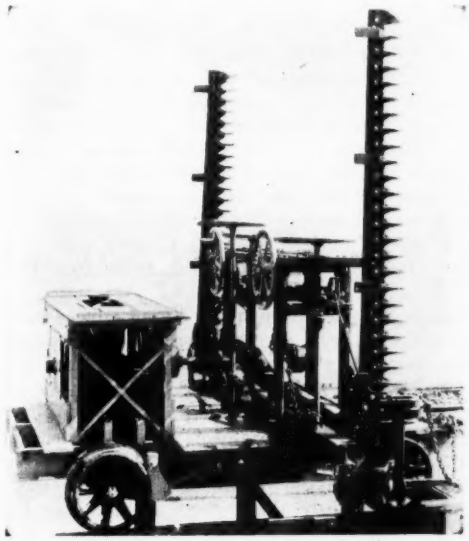
New and Improved Devices

Perfects New Fluid Hose

A NEW type of fluid hose that is claimed to possess qualities of high resistance to chemical action and physical wear has recently been perfected by the DeVilbiss Company, Toledo, Ohio. The advantageous qualities of this hose are attributed to the composition of the lining which contains only a small quantity of rubber. It is claimed that hot turpentine has no apparent effect on this hose and that in laboratory tests the absorption of lacquer thinner was only 1.8 per cent. It is said that the hose resists oils of the highest penetrating qualities and that gasoline, oil and grease do not swell, harden, break down or deteriorate the hose. Rigorous physical tests have been applied to this hose without any effect on its original flexibility, it is said.

New Fairmont Mowing Machine

FAIRMONT Railway Motors, Inc., Fairmont, Minn., has produced another of its series of M24 track mowers, known as the B1(M24) track mower, on which the sickles are raised and lowered by means of hand-operated hoists and the height of the inner end of the cutter bars is set by a positioning chain. This model is said to be particularly adaptable to the cutting of



The Fairmont B1(M24) Track Mower.

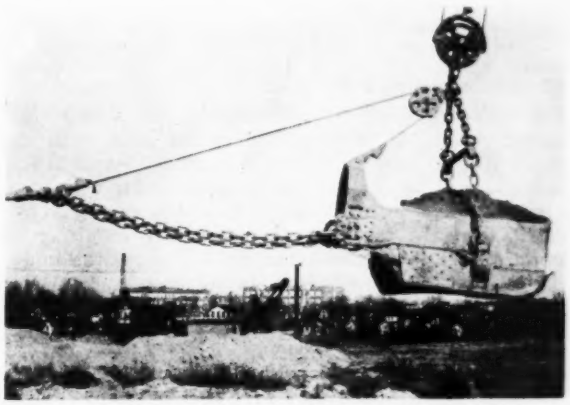
weeds on low ballast sections where variation of the inner shoe position is seldom required, and where there are few obstructions to compel the raising of the sickles.

This machine may be equipped with a power lift for the sickles and apparatus for controlling the inner shoe height while mowing, and the further addition of vertically adjustable power heads renders the machine adaptable to use on high ballast sections. Because it is possible to make these additions, together with other minor changes, it is pointed out that a substantially less expensive machine is made possible without sacrificing cutting efficiency or quick changes for cutting a four-swath width.

The B1(M24) mower embodies the ball-bearing, volume-governed engine and turntable of the other models of the same series, and likewise is equipped with ball and roller bearings. The raising and tilting of each cutter bar is done by a handwheel 17 in. in diameter.

New Bucyrus-Erie Dragline Bucket

A NEW dragline bucket, known as the Red Arch Type X dragline bucket, has recently been perfected by the Bucyrus-Erie Company, South Milwaukee, Wis., and is being built in sizes ranging from ½ to 8 cu. yd. The arch of this bucket consists of a one-piece annealed steel casting which is provided with a universal dump-rope connection that eliminates the bending of the rope at the socket. Each side of the bucket is formed by an annealed steel casting, while the bottom is protected by runners and wearing plates of structural steel that are easily replaced. The bucket is equipped with a manganese steel lip on which are cast integrally the bases of the manganese steel teeth which are secured by means of simple wedges.



The Bucyrus-Erie Red Arch Type X Dragline Bucket

A special renewable trunnion bushing and cap of heat-treated alloy steel is provided, which is easily replaced, while the alloy steel trunnion link is also heat treated. A universal joint for the dump sheave is formed by a detachable heat-treated alloy steel clevis, while a heat-treated alloy steel hook-casting forms the connection for the hoist bail and dump rope block. The dump sheave is protected by a guard consisting of a one-piece lightweight steel casting.

On the Detroit, Grand Haven & Milwaukee (Grand Trunk Western)

What Our Readers Think

One Cause of Bridge Seat Failures

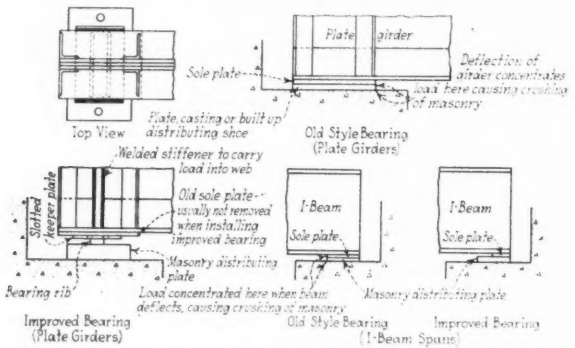
Chicago.

TO THE EDITOR:

I have read with interest the answers to the question regarding the repair of bridge seats, which appeared in the June issue of *Railway Engineering and Maintenance*, page 405. Neither of the answers, however, makes clear the real cause of most bridge seat troubles; namely, improperly designed shoes that fail to apply the load centrally on the masonry distributing plate, slab or casting. The reasons for damaged bridge seats that were given in these letters are as follows:

1. Improper or poor workmanship in the bridge seat.
2. Faulty drainage of the bridge seat.
3. An uneven bearing surface for the shoe.
4. Laitance under the shoe.
5. Churning of the shoe.
6. Shoes that are too small for the loads.
7. The setting of the span before the concrete has hardened properly.
8. Inferior concrete in the bridge seat.

In addition, however, investigation has shown that cracked, spalled or "churned-out" bridge seats occur almost invariably under the ends of beam and girder spans having sole plates that are of the same width, measured parallel to the span, as the supporting plate or shoe. This results from the fact that when the beam or girder is deflected under load, each end rotates about the inner edge of the sole plate, which, being directly above the


Sole plate
Plate girder
Deflection of girder concentrates load here causing crushing of masonry
Top View
Plate casting or built up distributing shoe
Old Style Bearing (Plate Girders)
Welded stiffener to carry load into web
Slotted keeper plate
Old sole plate—usually not removed when installing improved bearing
Masonry distributing plate
Bearing rib
Load concentrated here when beam deflects, causing crushing of masonry
I-Beam
Sole plate
Masonry distributing plate
Improved Bearing (Plate Girders)
Old Style Bearing (I-Beam Spans)
Improved Bearing

Suggested Improvement of Bearings for Beams and Short Girders

inner edge of the masonry distributing plate, transmits the load to the masonry along a line instead of over an area. In addition, as the live load passes over the span, the varying tension in the bottom flange of the beam or girder, accompanied by a variation in the flange length, causes a horizontal motion of the shoe, which, together with the vertical load, sets up a churning motion that ends to dig out the bridge seat. If the sole and bearing plates stick together, or "freeze," the churning effect is aggravated.

For beam spans, the proper distribution of the load on the masonry can be obtained by means of a very simple and economical form of bearing. It is only necessary to make the sole plate half as wide as the masonry distributing plate, with the inner edge of the sole plate at the center of the masonry plate. With this arrangement the load that is applied at the inner edge of the sole plate when the span is deflected is distributed over the bridge seat by cantilever action of the masonry plate in each direction from its center.

For heavier spans, an economical and effective bearing may be made by supporting the girder on a bearing rib about 1½ in. square in cross section, which is welded to a steel load-distributing slab. A keeper plate slotted to receive the bearing rib is fastened to the girder to hold it in place on the shoe.

In my opinion, the following factors, given in the order of their importance, are the most important in increasing the life of bridge seats.

(1) Properly designed shoes, with the load applied centrally on a correctly proportioned load-distributing bearing.

(2) A level bearing surface on the bridge seat without isolated high spots.

(3) A bearing area that is in proper relation to the load carried and the quality of the masonry.

(4) Proper drainage.

THEODORE DOLL,
Assistant Engineer, Bridge Department,
Atchison, Topeka & Santa Fe System.

Prefers Arithmetical Method

Oakridge, Ore.

TO THE EDITOR:

I have been very much interested in the article entitled Using a Graphic Method in String Lining Curves, by Thomas Walker, which appeared in the August issue of *Railway Engineering and Maintenance*, page 507. I have been using Charles H. Bartlett's method of string lining curves since his articles appeared in your publication in 1928, and a short time prior to the appearance of Mr. Walker's article I had been comparing a graphic method used on another division of our road with Mr. Bartlett's method. Mr. Walker plots the cumulative middle ordinates while in the other graphic method referred to values representing the middle ordinates are plotted. However, both graphic methods are based on the principles that were outlined by Mr. Bartlett.

In my opinion the arithmetical method of calculating the exact throws is by far the most accurate and useful method and can be applied to field work more readily than the graphic methods. My experience has been that our foremen can master Mr. Bartlett's method if they make up their minds to do so, and after some practice they will line many curves that otherwise would not be lined.

The main advantage of string lining curves is that it avoids the necessity of calling on the engineering department for center stakes every time we need a curve lined. The engineer's efforts should be used on more valuable work than staking curves if there is a way of lining the curves without his assistance. Bartlett's arithmetical method makes this possible without assistance from any one except possibly the roadmaster. Our foremen who cannot actually figure the throws are all able to take the field measurements and stake the curve for lining after I give them the throws. I usually go out on the line with them when they desire to line a curve and make the calculations on the ground while the gang is doing other work in that vicinity.

Mr. Walker's graphic method would be of value to office men in visualizing a revised curve if notes are sent to them to be worked up and could be used to advantage as a preliminary step.

It might be of education to us if other railway men would contribute their ideas and methods on the subject of string lining. There always seems to be something new.

ROY W. PUTNAM,
Roadmaster, Southern Pacific.

News of the Month . . .

Missouri Pacific Relief Funds

During the period from November 1, 1931, to June 30, 1932, the Missouri Pacific and its employees expended a total of $117,652 in extending relief to unemployed workers of the railroad. During that time, a total of $127,721 was raised through a special donation of $25,000 by the company and voluntary contributions of ½ of 1 per cent of the salaries of officers.

Railway Employment

As of the middle of June the number of railway employees on Class I railroads of the United States totaled 1,047,483, which was a reduction of 34,113 as compared with the number in May and a reduction of 269,556, or 20.49 per cent, as compared with the number in June of last year. The number of employees in the maintenance of way and structures group as of the middle of June, totaled 233,848, which was a decrease of 76,196, or 24.58 per cent, from last year.

Uphold Missouri Truck Law

The constitutionality of the Missouri State bus and truck law, which went into effect on September 14, 1931, to govern the size, weight, routes, rates and tariffs of motor vehicles operating in that state, was upheld by a special federal tribunal of three judges at Kansas City, Mo., on July 28, when it denied the application of the Schwartzman Service Company of St. Louis for an injunction to restrain the Missouri Public Service Commission from enforcing the act.

A Double-Deck Suburban Coach

The double-deck design of passenger coaches made its first entry into the railroad field recently when the Long Island installed such a coach in trial commutation service. In this coach the seats are installed in a staggered arrangement on upper and lower levels along both sides of the car, giving the car a seating capacity of 120 passengers as compared with 76 for the suburban coaches now in service.

More Employee Clubs

Organizations of railroad employees and other persons sympathetic to the railroad cause are continuing to spring up at various points throughout the country. On July 21 an enthusiastic meeting of railway and express company employees was held at Rock Hill, S. C., and a local organization of these employees was formed. Tennessee employees have formed a state association known as the Tennessee Employees and Citizens League, while in Canada a total of 21 "ship-by-rail" clubs are functioning and broadening their activities. Employees of the Chicago, Rock Island & Pacific have recently formed organizations at various points in Kansas.

Freight Traffic in June

Freight traffic carried by the Class I railroads in June amounted to 18,667,790,000 net ton-miles, which was a reduction of 9,586,036,000 net ton-miles, or 33.9 per cent, as compared with June, 1931, and a reduction of 15,749,659,000 net ton-miles, or 45.8 per cent, under June, 1930. The total for the first six months of 1932 was 127,935,913,000 net ton-miles, a reduction of 26.6 per cent under the corresponding period of 1931, and of 84,309,150,000 net ton-miles, or 39.7 per cent, under 1930.

Income for Six Months 1.01 per cent

For the first six months of 1932, Class I railroads of the United States had a net railway operating income of $112,329,374, which was at the annual rate of return of 1.01 per cent on their property investment, as compared with a net of $240,504,555, or 2.16 per cent, in the same period of 1931, according to reports compiled by the Bureau of Railway Economics. Operating revenues for the first six months totaled $1,601,441,499, as compared with $2,187,563,109 for the corresponding period of last year, a decrease of 26.8 per cent. Operating expenses amounted to $1,280,607,169 as against $1,716,730,131 last year, a decrease of 25.4 per cent, while taxes decreased 8.7 per cent from $163,400,736 to $149,202,085.

Excludes Common Carrier Truck Lines

The State Road Commission of West Virginia, acting under authority conferred by the motor vehicle law of that state, has decided not to permit Class I common carrier trucks to operate over the highways of the state, where the same service is being performed adequately by other carriers. In announcing the decision, it was stated that "to place truck lines on the highways in competition with adequate railroad service would mean damage to the public highways far in excess of the value of the public service rendered." Interference with other vehicles and the eventual necessity of higher railroad freight rates caused by a smaller volume of business were other reasons for the decision.

R. C. C. Loans to Railroads

On August 1, the Railroad Credit Corporation, the organization that was formed to administer to needy carriers for their fixed interest obligations the funds derived from the increase in freight rates that went into effect on January 4, had authorized loans to railroads of $28,388,465, according to the monthly report filed with the Interstate Commerce Commission. Of this amount $20,445,441 represented loans made.

Holds "Train-Limit" Law Unconstitutional

Holding that the Arizona "train-limit" law of 1912, limiting the length of freight trains operated in that state to 70 cars and of passenger trains to 14 cars, is unconstitutional and unjustified in every respect, Joseph E. Morrison, special master in chancery, has presented a report to the United States District Court of Arizona holding that the law be held null and void so far as it applies to all interstate traffic.

Eight-Hour Day for Truck Operators

In at least one state the same limitations regarding the number of hours that railroad employees are permitted to work have now been applied to operators of buses and trucks. The State Corporation Commission of Virginia has promulgated and put into effect an extensive code of regulation of commercial motor transport, one rule of which states that no driver or operator of a commercial motor vehicle shall be required or allowed to work as such more than eight hours in any 24-hr. period, and that such drivers shall have at least eight consecutive hours' rest in every 24-hr. period.

Security Owners Urged to Act

The Railroad Owners Association, an organization of holders of railroad securities, has sent letters to its members requesting them to write to Senators and Congressmen urging the passage of regulatory measures for buses, trucks, airplanes and waterways. The letters also advise the members to write to railroad presidents calling their attention to the fact that the rate of six per cent paid to the Reconstruction Finance Corporation for loans is entirely too high and recommending that companies buy their own bonds at present low prices with money obtained from the Finance Corporation with the bonds as collateral.

Consider Loans to Repair Equipment

The Association of Railway Executives, at a meeting at New York on August 10, took no official or collective action on the proposal that the railroads borrow funds from the Reconstruction Finance Corporation for the purpose of repairing equipment and perhaps for the purchase of new equipment as a means of increasing employment, except to say that the "critical conditions of unem-

ployment were such that grave consideration should be given to the matter." In a statement issued by the Advisory committee of the association it was said that the matter had been referred to the roads as individuals.

Seatrain Service

The transportation of railroad cars by water between New York and Havana, Cuba, is soon to be undertaken by Seatrain Lines, Inc., which has operated a similar service between New Orleans, La., and Havana for the last three years. In preparation for the new service the company has ordered two vessels for carrying cars, each of which will have a capacity of 100 cars and will cost about $1,580,000. Operation of the line will be inaugurated in September.

Observe Motorists at Crossings in Safety Survey

The Committee on the Prevention of Highway Crossing Accidents of the Safety Section, American Railway Association, has just made public the results of a nation-wide survey of the conduct of motorists in approaching and passing over railroad-highway grade crossings, showing that 74 per cent of those under observation exercised reasonable care, 14 per cent were classed as reckless and 12 per cent came so close to the border line as to leave it debatable as to whether the motorists were using reasonable care or were reckless.

New Freight Cars and Locomotives

In the first six months of 1932 the Class I railroads of the United States placed in service 1,927 new freight cars, as compared with 6,951 in the same period last year, according to the Car Service Division of the American Railway Association. The railroads also placed in service in the first half of this year 34 new locomotives compared with 89 in the same period in 1931. On July 1 of this year these roads had 1,951 new freight cars on order as against 8,963 on the same day last year, while the locomotives that were on order on that date totaled 6 as compared with 36 on the same day of 1931.

Points to Railroad Buying as Big Economic Factor

"Normal buying by the railroads is the greatest single potential economic force in the country today," stated W. S. Rugg, vice-president of the Westinghouse Electric & Manufacturing Company, in a recent radio talk, in which he advocated the wide use of funds loaned by the Reconstruction Finance Corporation in a comprehensive program to rehabilate the country's transportation facilities. Mr. Rugg traced the beneficial effects of increased railroad buying through all branches of industry, stating that even at their present low ebb, railway purchases benefit "every state, every community and every product."

Association News

The Roadmasters' Association

Following the postponement of the convention this year, the Executive committee has selected the Hotel Stevens, Chicago, as headquarters for the 1933 convention which will be held on September 19-21, 1933.

Bridge and Building Association

Plans are being made for a meeting of the Executive committee in Chicago late in September, at which time definite action will be taken relative to the postponement of the convention now scheduled to be held in Toronto, Ont., on October 18-20.

Maintenance of Way Club of Chicago

Owing to the fact that there will be no convention of the Roadmasters' Association this fall, it is planned to hold the Annual meeting of the club in September instead of waiting until October as was done in previous years to avoid a conflict with the Roadmasters annual meeting. The date has been set for Wednesday evening, September 21.

American Railway Engineering Association

Four committees held meetings during the month of August. Three of these met in Chicago, namely, the Committee on Work Equipment, on August 9-10, with an attendance of 14; the Committee on Water Service, on August 16, with an attendance of 18, and the Committee on Rules and Organization on August 19, with an attendance of 12. The Committee on Records and Accounts met at Detroit on August 18, with an attendance of 14.

The Proceedings of the Association for 1932 are being delivered by the printer and will be mailed early this month. In addition to this and to Bulletin 346, copies of which were mailed in August, members will soon receive Bulletin 347 which will contain all revisions of and additions to the Manual occasioned by action taken at the convention held in March.

Railroad Taxation and Schools

Schools of the country are depending for their operation to an increasing extent on funds obtained from railroad taxation. In the state of Georgia in 1930 the railroads paid taxes of $4,367,510, of which at least $1,250,000 went for the support of the schools. In some school districts the railroads pay more than half the taxes, while railroad taxes in Georgia have steadily increased at the same time that other taxes have been decreasing.

Personal Mention

General

Mariano Cabrera, formerly executive vice-president and general manager of the National Railways of Mexico and more recently sub-secretary of the department of communications of Mexico, and an engineer by training and experience, has been elected executive president of these lines, with headquarters at Mexico, D. F. Mr. Cabrera succeeds **Javier Sanchez Mejorada,** also an engineer of broad experience, who has resigned. **Lorenzo Perez Castro,** executive vice-president, who has served in various engineering capacities with the Mexican national railways, has also resigned.

Robert H. Boykin, superintendent of the Mahoning division of the Erie, with headquarters at Youngstown, Ohio, and an engineer by training and experience, has been promoted to assistant general manager of the Eastern district, with headquarters at Jersey City, N. J. Mr. Boykin was born at Petersburg, Va., in

Robert H. Boykin

1886. Shortly after he completed a course in civil engineering at Columbia university he entered the service of the Erie as an axeman in the engineering department at Corry, Pa. In 1910, after serving in various capacities, he was promoted to foreman on construction, being advanced to general foreman a year later. In 1915, Mr. Boykin was further promoted to division engineer of the Kent division, shortly thereafter being transferred to the Delaware and Wyoming divisions. Three years later he was promoted to assistant superintendent of maintenance, which position he held until the advent of Federal control of the railroads, when he was made assistant superintendent of terminals at Jersey City. With the return of the railroads to private control, Mr. Boykin was appointed superintendent of terminals, and in 1929 he was made superintendent of the Mahoning division, the position which he was holding at the time of his recent promotion.

RE-APPLICATION IS IMPORTANT

the Woodings Rail Anchor is unexcelled in its ability to stand up under re-application.

After extensive tests on one of the largest and most prominent railroads in this country it has been developed that

WOODINGS FORGE & TOOL CO.

WORKS AND GENERAL OFFICES

VERONA, PENNA.

J. F. Earl, division engineer of the Portage division of the Canadian Pacific, whose appointment as assistant superintendent of part of the Moose Jaw division, with headquarters at Moose Jaw, Sask., was noted in the August issue, was born on December 25, 1880. After completing his education he entered railway service on May 1, 1900, with the Canadian Pacific, serving with this road until 1906, when he left to go with the engineering department of the National Transcontinental (now part of the Canadian National). Seven years later Mr. Earl returned to the Canadian Pacific as an assistant engineer, being appointed a roadmaster in 1914. After serving in the latter position at Winnipeg, Man., and Kenora, Ont., he was appointed a resident engineer in 1918, with headquarters at the former point. In 1920, Mr. Earl was transferred to the operating department as an assistant superintendent, at Minnedosa, Man., later being transferred to Kenora. He was appointed division engineer at Winnipeg in 1931, which position he was holding at the time of his recent appointment as assistant superintendent, effective July 1.

Engineering

Salvador Madrazo Arcocha has been appointed chief engineer of the National Railways of Mexico, with headquarters at Mexico, D. F., succeeding **Heron Cabrera.**

Duncan R. Campbell, general superintendent of construction of the Western region of the Canadian National, with headquarters at Winnipeg, Man., retired on July 31, after 36 years service with this company. For the present the position vacated by Mr. Campbell will not be filled.

Thomas Martin, who has been supervising the construction of the Vancouver tunnel of the Canadian Pacific, has returned to his former position as division engineer of the Portage division, with headquarters at Winnipeg, Man. He replaces **J. F. Earl,** who has been appointed assistant superintendent, with headquarters at Moose Jaw, Sask., as mentioned elsewhere in these columns under general.

P. D. Fitzpatrick, assistant chief engineer of the Canadian National in charge of the construction of the new Montreal, Que., terminal, has been appointed chief engineer of the Grand Trunk Western (a subsidiary of the C. N. R.), with headquarters at Detroit, Mich., to succeed **J. A. Heaman,** who has been appointed office engineer on the headquarters staff of the Canadian National, with headquarters at Montreal.

Fitzpatrick was born at Springfield, Ill., and was educated at the Armour Institute of Technology, Chicago. He entered railway service in 1894 on track elevation work with the Chicago & North Western, going with the Illinois Central three years later as an assistant engineer. In 1905, Mr. Fitzpatrick left railway service to become superintendent and engineer with a general railroad construction concern. Seven years later he became an assistant engineer on the construction of the Kansas City, Mo., terminal. He first entered the service of the Canadian National in May, 1913, when he joined the engineering staff of the Grand Trunk Western on the construction of a terminal at Bay City, Mich. Several months later he was appointed division engineer on the Southern New England in charge of the construction of this Grand Trunk project, and in February, 1916, he was appointed valuation engineer of the Central Vermont (also a subsidiary of the C. N. R.), later being assigned the duties of general road-

P. D. Fitzpatrick

master. In 1918, Mr. Fitzpatrick was advanced to chief engineer, which position he held until the spring of 1930, when he was placed in charge of the terminal project of the C. N. R. at Montreal as assistant chief engineer. He was holding this position at the time of his recent appointment as chief engineer of the Grand Trunk Western.

Track

W. T. Trisler, a roadmaster on the St. Louis-San Francisco, has had his headquarters moved from Joplin, Mo., to Cherokee, Kan.

P. F. Francis, an engineer in the construction department of the Canadian Pacific, has been appointed roadmaster on the Moose Jaw division, with headquarters at Milden, Sask., where he replaces **C. Bradshaw,** who has been appointed a track foreman.

Dave Bogue, roadmaster on the Panhandle division of the Chicago, Rock Island & Pacific, with headquarters at Haileyville, Okla., has been appointed a track inspector and his territory has been distributed among other roadmasters. Mr. Bogue's appointment follows the application of the track inspector system of track supervision to this division.

H. C. Larson, a track foreman on the Chicago Great Western, has been promoted to roadmaster, with headquarters at Des Moines, Iowa, to succeed **R. O. Dougherty,** who has been transferred to Stockton, Ill., where he replaces **J. Farrell,** who has been assigned to other duties. **I. Strom,** also a track foreman, has been promoted to roadmaster, with headquarters at Clarion, Iowa, to succeed **L. H. Brien,** who has been transferred to Carroll, Iowa, to replace **W. P. Clear,** who has been assigned to other duties.

M. W. Stevens, supervisor of track on the Omaha division of the Chicago, Burlington & Quincy, at Omaha, Neb., has been promoted to roadmaster, with jurisdiction from Denver, Colo., to Wray, and from Denver to Lyons, with headquarters at Denver, succeeding **P. G. Herigstad,** deceased.

John Sexton, roadmaster on the Delaware, Lackawanna & Western, with headquarters at Hopatcong, N. J., has retired after 57 years of continuous service with this road, 33 of which were as a roadmaster. Mr. Sexton was born in 1862, at Washington, N. J., and began service with the Lackawanna as a tool boy and flagman in 1875. Three years later, at the age of 16, he was advanced to track foreman with headquarters at Delaware, N. J., where he remained until 1890, when he was appointed work train and switch foreman at Stroudsburg, Pa. Nine years later Mr. Sexton was further promoted to roadmaster, with headquarters at Washington, later being transferred to Hopatcong. He was located at this point until his retirement.

Obituary

P. A. Ross, superintendent of the wood preserving plant of the Southern Pacific at Alamagordo, N. M., died on August 14.

William L. Bennett, supervisor of track on the Chesapeake & Ohio, with headquarters at Thurmond, W. Va., died at that place on July 4.

P. G. Herigstad, a roadmaster on the Chicago, Burlington & Quincy, with headquarters at Denver, Colo., died at that place on July 24, following a week's illness.

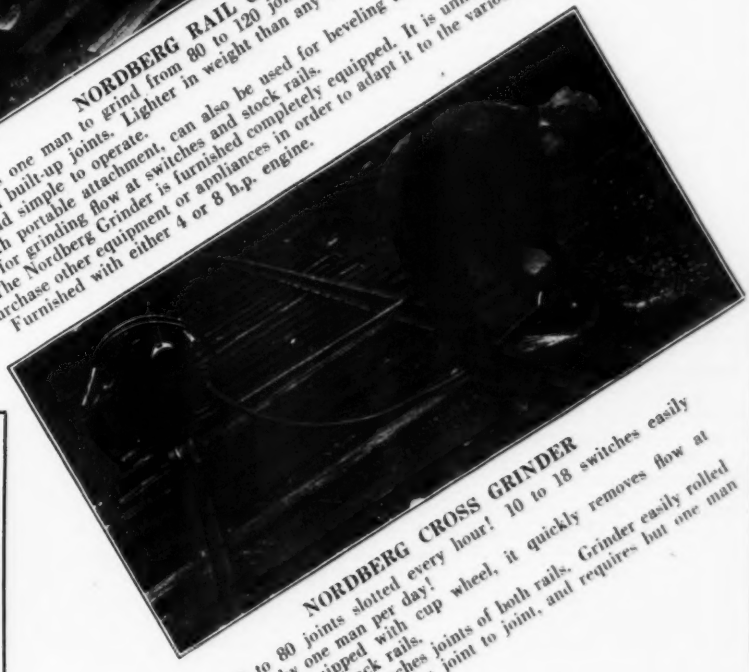
Edward Howell, who retired about a year ago as general foreman of steel erection of the Chicago, Milwaukee, St. Paul & Pacific, Lines West, died on August 21, at Adams, Minn.

James B. Cox, who resigned as chief engineer of the Chicago Junction in 1905, died at Chicago on July 31. He was born on October 30, 1857, and was educated at Pennsylvania college. He entered railway service in 1880 as a rodman on the Pennsylvania, which position he held until 1882, when he was promoted to assistant supervisor. From 1889 to 1895 he engaged in private engineering practice and in the latter year became assistant engineer on the Chicago, Hammond & Western (now part of the Chicago Junction). He held this position until June 1, 1898, when he was appointed chief engineer of the Chicago Junction. In 1905 he resigned from this position to become a consulting engineer, which occupation he followed until his death. Mr. Cox was a charter member of the American Railway Engineering Association and had served as a member of the Committee on Arrangements since the inception of the organization.

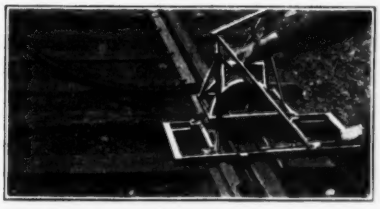
When "Doctoring Up" those rail ends and maintaining switches

Better work and quicker work—that's what's expected of rail-end-repairing machinery today! Nordberg Grinders have repeatedly and conclusively proven their ability to meet and surpass the requirements.

NORDBERG RAIL GRINDER Enables one man to grind from 80 to 120 joints per day. Puts a perfect "top" on built-up joints. Lighter in weight than any similar machine. Sturdy, easy and simple to operate. With portable attachment, can also be used for beveling and slotting joints and for grinding flow at switches and stock rails. The Nordberg Grinder is furnished completely equipped. It is unnecessary to purchase other equipment or appliances in order to adapt it to the various jobs. Furnished with either 4 or 8 h.p. engine.



NORDBERG CROSS GRINDER 60 to 80 joints slotted every hour! 10 to 18 switches easily ground by one man per day! When equipped with cup wheel, it quickly removes flow at switches and stock rails. Flexible shaft reaches joints of both rails. Grinder easily rolled along the rail and from joint to joint, and requires but one man to remove from track.



NOW . . . *machine shop precision in grinding slots!*

Absolute accuracy is assured with the new Nordberg Slotting Guide. Grinds to any depth, without danger of wheel being pinched or broken.

Vertical or "V" slots, as desired. Every slot of the same identical shape. Heavy heat treated rails can be cut perfectly with the aid of this guide. In normal service, a joint per minute can be slotted.

May we send you full information, also particulars on other Nordberg Maintenance Machinery?

Nordberg Grinders pay their way *all* the time, because they may be used for miscellaneous work, such as grinding switch points and frogs, when Grinders are otherwise idle.

RAILWAY EQUIPMENT DEPARTMENT

NORDBERG MFG. CO., MILWAUKEE, WIS.

NORDBERG MAINTENANCE MACHINERY

Supply Trade News

General

The United States Steel Corporation has authorized an expenditure of about $5,000,000 for the replacement and improvement of equipment in several of its plants in Ohio, Illinois-Indiana, Alabama and Pennsylvania, according to an announcement of **Myron C. Taylor,** chairman of its finance committee. The production and installation of this equipment will give employment to a considerable number of men throughout the winter.

The Franklin Railway Oil Corporation, with main office and works at Franklin, Pa., and division offices at New York, Kansas City, Dallas, and Los Angeles, will, in the future, handle sales for the following oil companies operating throughout the United States, acting as their railroad department, specializing in railroad lubricants: Standard Oil Company of New York, New York; White Eagle Oil Corporation, Kansas City, Mo.; Magnolia Petroleum Company, Dallas, Texas; General Petroleum Corporation, Los Angeles, Cal.; Vacuum Oil Company, Inc., New York; White Star Refining Company, Detroit, Mich.; Wadhams Oil Company, Milwaukee, Wis.; and Lubrite Refining Company, St. Louis, Mo.

Personal

F. M. Condit, formerly district manager of **Fairbanks, Morse & Company,** Chicago, has been appointed a representative of the **Track Supply Company,** Chicago.

Norman W. Foy, assistant western manager of sales of the **Republic Steel Corporation,** with headquarters at Chicago, has been promoted to Chicago district sales manager, to succeed **H. S. Schroeder,** resigned.

Lester T. Burwell, until recently vice-president of the **Q. & C. Company,** New York, is now president of the **Rails Company,** New York, which has been formed to promote the development and use of Airtrol air-conditioning and pre-cooling systems and other railroad equipment.

Paul W. Cotton, for the past 15 years northwest manager of sales for the **Pacific Coast Steel Corporation,** a subsidiary of the **Bethlehem Steel Company,** with headquarters at Seattle, Wash., has been transferred to San Francisco, Cal., as general manager of sales for the same company, with jurisdiction over the Pacific Coast sales.

Robert Gregg, president of the **Atlantic Steel Company,** Atlanta, Ga., has resigned to become vice-president of the **Tennessee Coal, Iron & Railroad Company,** a subsidiary of the United States Steel Corporation, at Birmingham, Ala., succeeding **Willard Wilson,** for many years vice-president in charge of sales of the Tennessee Coal, Iron & Railroad Company, who has retired.

Ross F. Hayes, 50 Church street, New York, for many years with the Curtain Supply Company and later with the Adams & Westlake Company, after the merger of those companies, has returned to the manufacturers' agency field and the sale of steam and electric railway and bus supplies. Mr. Hayes continues as eastern sales agent for the Henry Giessel Company, Chicago, water coolers, and the Hastings Signal & Equipment Company, Boston, Mass., bridge warnings and is prepared to handle the products of additional railway supply manufacturers who may desire eastern territory sales representation.

H. A. Morrison, business manager of Railway Signaling, with headquarters at Chicago, has been appointed western manager in charge of advertising sales in the western territory for the **Simmons-Boardman Publishing Company,** publishers of *Railway Engineering and Maintenance,* the Railway Age and other transportation magazines. He succeeds **J. Mack Rutherford,** whose death is noted elsewhere in these columns. Mr. Morrison first entered railway service in 1912, in the traffic department of the Pennsylvania at Indianapolis, Ind., leaving the employ of this road three years later to become a special apprentice in the electrical department of the Chicago, Rock Island & Pacific at Silvis, Ill. In June, 1918, he was transferred to the general mechanical superintendent's office at Chicago. On September 1, 1919, he resigned to become a sales engineer for the United States Light Corporation, with headquarters at Chicago, where he remained until May 1, 1924, when he was promoted to district manager in charge of railway sales. He resigned from this position on May 1, 1925, to become a sales representative of the Simmons-Boardman Publishing Company and on July 1, 1930, he was appointed business manager of Railway Signaling, which is also published by that company. Mr. Morrison will continue to discharge the duties of the latter position in addition to those of manager in charge of advertising sales in the western territory.

H. A. Morrison

Obituary

J. Mack Rutherford, western advertising manager of the Simmons-Boardman Publishing Company, publishers of *Railway Engineering and Maintenance,* Railway Age and other transportation magazines, with headquarters at Chicago, died suddenly on July 28, in St. Luke's Hospital in that city, following a minor operation. He was born on May 18, 1892, at Grinnell, Iowa, and came to Chicago in 1897. After a public school education, Mr. Rutherford entered the service of the Clarke Stove Company, Chicago, and a short time later went with the Chicago Tribune in its classified advertising sales department. In 1916, he became connected with the Simmons-Boardman Publishing Company at Chicago, as an advertising salesman, and on October 1, 1929, he was promoted to western manager in charge of advertising sales, the position he was holding at the time of his death. Mr. Rutherford was active in advertising circles in Chicago, being a charter member and a director of the Dotted Line Club; he had also served as a director of the Engineering Advertising Association of Chicago.

J. Mack Rutherford

Trade Publications

Inland Four-Way Floor Plate.—An eight-page folder describing and illustrating the four-way floor plate which was recently developed by the Inland Steel Company, Chicago, is being distributed by this company.

Caterpillar Sixty-Five Tractor.—The Caterpillar Tractor Company, Peoria, Ill., is distributing a 40-page, attractively-illustrated booklet, which is devoted to an account of the various features of the Model 65 Caterpillar tractor.

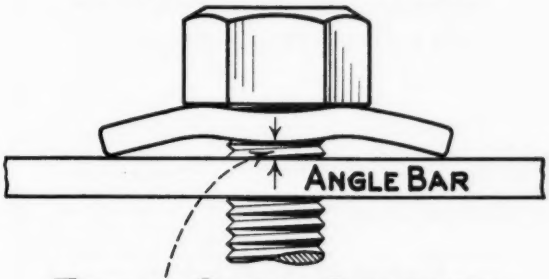
Murex Heavy Mineral-Coated Electrodes.—The Metal & Thermit Corporation, New York, has published a booklet giving the various applications of its Murex heavy mineral-coated electrodes, which include the building up of rail ends, and special manganese trackwork as well as the repair of castings and heavy parts.

Now You Can Get A Spring Washer Powerful Enough To Maintain Proper Bolt Tension And Yet Guard Against Overtightening

VERONA TRIFLEX SPRING

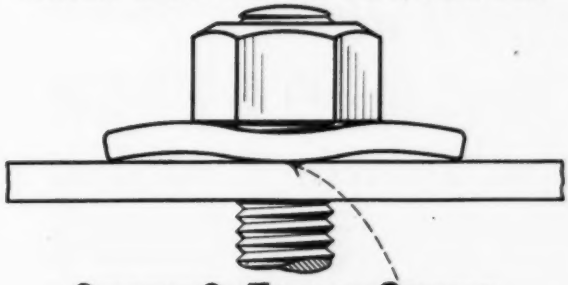
A Calibrated Spring
The only Spring Washer giving visible indication of bolt tension

START-BOLT TENSION ZERO



TRIFLEX SPRING CLEARANCE BEFORE WRENCHING

FINISH-BOLT TENSION 20,000 LBS



CENTER OF TRIFLEX SPRING TOUCHES ANGLE BAR

Verona Triflex Spring is designed and manufactured to provide a clearance between the center of the spring and face of the angle bar before bolt is tightened; approximately one complete turn of the nut increases the bolt tension from zero to twenty thousand pounds and brings the center of Verona Triflex in contact with the face of the angle bar, providing a simple and positive means for obtaining equal and proper tension in all bolts and by this means provides insurance against frozen joints and their attendant evils.

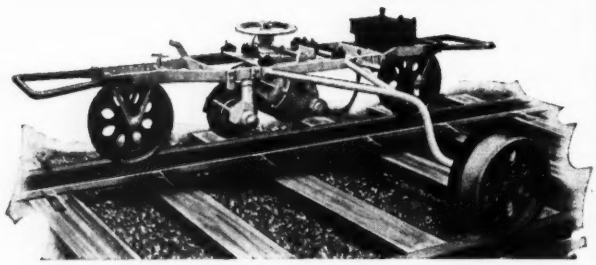
VERONA TRIFLEX SPRING

A Device of High Reactive Spring Pressure

Woodings-Verona Tool Works

Since 1873

Verona, Pa.



Railway Track-work Company Portable Electric Track Grinder, Model P-8

Two wheels on one rail. Outrigger on opposite rail, quickly removable, permits grinder on neutral ground to pass train. Electric motor operates grinding wheel at 9000 surface ft. per min. Adjustable laterally and vertically. May be reciprocated 16-in. Flexible shaft carries grinding wheel for beveling joints.

don't class

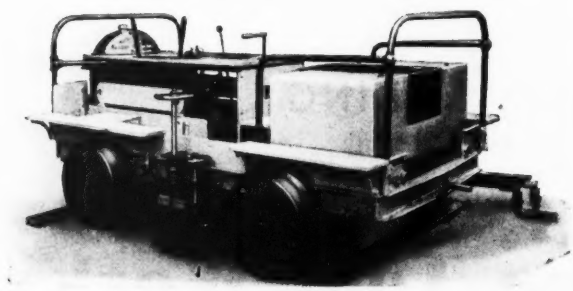
RAIL BATTER

as a minor defect

It's a symptom of big expense ahead unless the remedy is applied immediately. The penalty of neglect is damaged track and roadbed. Prompt rejuvenation of battered rail costs little, saves much. Build up the surface by arc welding, grind off to true contour with Railway Track-work grinders. They do the job with speed, accuracy, economy. Bulletins describe various types. Write for them.

Railway Track-work Co.

3132-48 East Thompson Street Philadelphia



Railway Track-work Company Portable Reciprocating Grinder, Model P-7

Propelled and operated by 40 h.p. Ford Industrial gasoline engine. An economical machine for surfacing joints in new track. Grinds by reciprocation instead of rotation. Produces a smooth surface, maintains original rail contour, removes minimum metal. Two grinding blocks on each rail make 200 strokes per min. Quick derailing.

1243

BOOKS THAT HELP MAINTENANCE MEN

Track and Turnout Engineering

By C. M. KURTZ

Engineer, Southern Pacific Company

This new handbook for location, construction and maintenance of way engineers, transitmen and draftsmen, gives practical mathematical treatment of track layout and other problems. These are fully exemplified and worked out in detail, and illustrated with drawings of accepted designs for fixtures and track layouts. It contains original as well as a complete set of standard railway engineering handbook tables. All computing problems which may arise in track engineering are thoroughly treated.

457 pages, 116 illustrations, 33 tables, flexible binding, 5x7, $5.00

Practical Track Work

By W. F. RENCH

Formerly Supervisor, Pennsylvania Railroad

A new book giving expert information on the design, fabrication and installation of standard railroad trackwork. Thoroughly describes switch stands, switches, frogs, crossings and slip switches.

256 pages, 110 illustrations, tables, flexible binding, 5x7, $1.50

Roadway and Track

By W. F. RENCH

Packed full of practical information written on a background of 25 years experience. The meat of modern maintenance practice is in this book. It is the most complete work on the subject.

Second Edition, 226 pages, 44 illustrations, cloth, 6x9, $2.00

Simplified Curve and Switch Work

By W. F. RENCH

Formerly Supervisor on the Pennsylvania

This little book has practically revolutionized curve and switch calculation practice since its appearance 12 years ago. The proved accuracy of its methods has caused them to be adopted as standard practice on many roads.

Complex algebraic and geometric calculations are reduced to their simplest form and as nearly as possible to terms of simple arithmetic. Application of these calculations to the actual job is made plain by brief explanations. Drawings further clarify the subject and make the meaning of the text unmistakable. Tables of dimensions are a further help to the track foreman.

Short cut formulae are featured. String lining and tape line layouts are fully explained. While retaining practically all of the rules and principles which have been tested in previous editions, changes have been made in several detailed features to correspond to improved designs. A flexible binding makes the new edition more convenient to slip in the pocket and carry on the job.

Fourth Edition, 212 pages, 24 illustrations, 5x7, cloth, $2.00

SIMMONS-BOARDMAN PUBLISHING CO.,
30 Church St., New York.

Please send me for 10 days' free examination the books checked below. I will either remit list price or return the books within that time.

☐ Simplified Curve and Switch Work
☐ Practical Track Work
☐ Track and Turnout Engineering
☐ Roadway and Track

Name.....

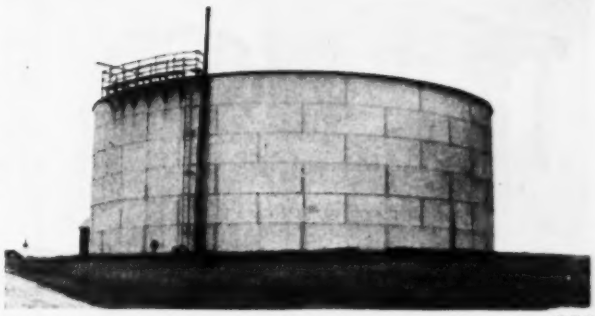
Address.....

City..... State.....

Position.....Company..... RE&M 9-32

Improved Tank Protection

NO-OX-ID FILLER RED has the same chemical properties of rust prevention as the other NO-OX-IDs but is semi-drying on the surface, offering an excellent bond for paint (especially aluminum), while beneath the surface the FILLER RED remains a plastic protective rust inhibitor. Very interesting reports are available showing the advantage of this primer over other primer coats. One tank coated in 1926 with NO-OX-ID and painted over is still reported in perfect shape, while a tank close by painted at the same time with red lead and black point, "has a good many rust spots and pitting."



Protected with NO-OX-ID. The NO-OX-ID inside does not make water taste or unfit it for domestic use.

Coated inside and outside with NO-OX-ID in 1927. Reported still "in good shape."

Paint Over NO-OX-ID FILLER RED
and know the Steel Beneath is Safe

Use of NO-OX-ID FILLER RED is a sensible economy that lengthens the duration of protection. Made in gray and black also. Details and recommendations on request.

Dearborn Chemical Company

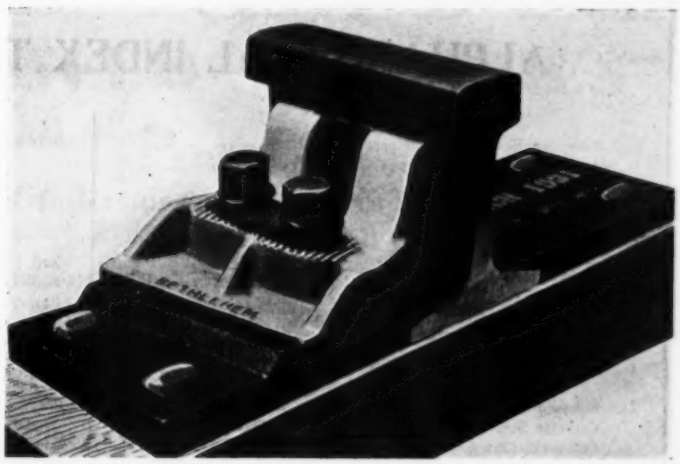
205 EAST 42ND STREET, NEW YORK
310 S. MICHIGAN AVENUE, CHICAGO
Canadian Factory and Offices:
2454-2464 Dundas St., W., Toronto

NO-OX-ID
IRON-OX-RUST
TRADE MARK
The Original Rust Preventive

BETHLEHEM
Adjustable Rail Brace
DESIGN 831

An additional margin of safety at switches is provided by the use of Bethlehem Adjustable Rail Braces. These braces hold the stock rails of switches firmly in position, assuring the correct fit of the switch points against the stock rails, preventing their becoming chipped and broken, and thus greatly prolonging their life. The close adjustment possible with Bethlehem Adjustabe Rail Braces permits proper maintenance of gage and easy, quick adjustment for wear of the stock rails, thereby considerably reducing the cost of switch maintenance.

The Bethlehem Adjustable Rail Brace, a malleable iron casting, fits over the top of the base, against the web and beneath the head of the rail. The base of the brace rests upon a rolled-steel tie plate, the heel abutting a diagonally-formed shoulder on top of the plate. The brace is fastened to the tie plate by nuts equipped with spring washers, and bolts countersunk in the bottom of the plate. A corrugated keeper fitting the serrated top of the brace permits easy and quick adjustment.



The Bethlehem Adjustable Rail Brace, Design 813, when driven to a firm bearing against the rail and locked in position, holds the rail to correct gage.

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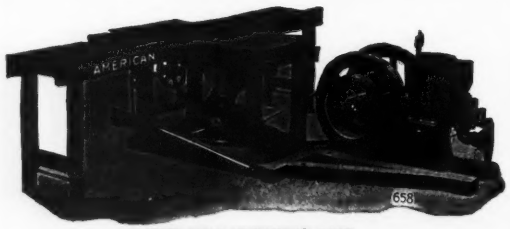

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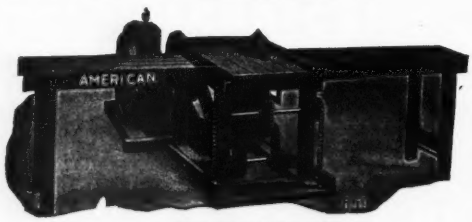

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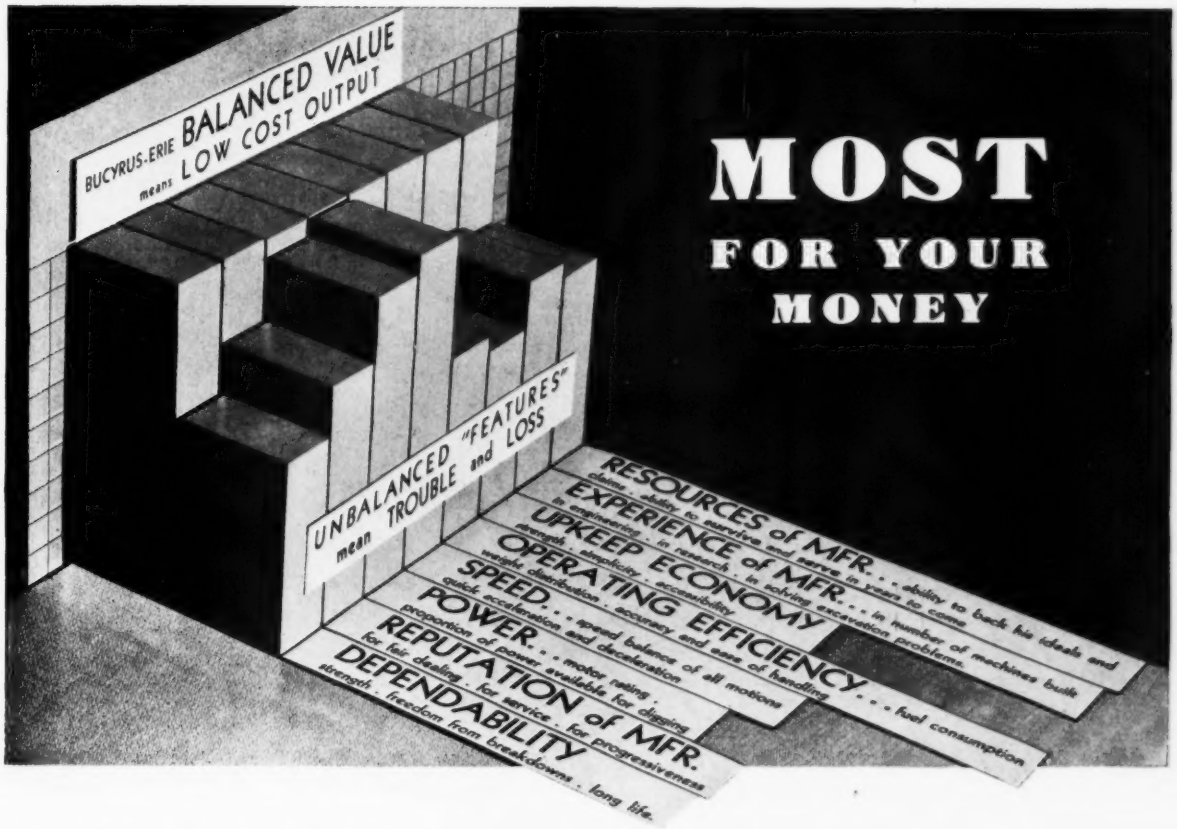
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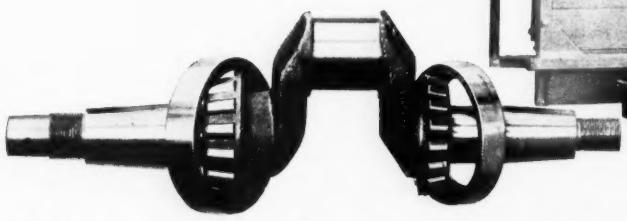
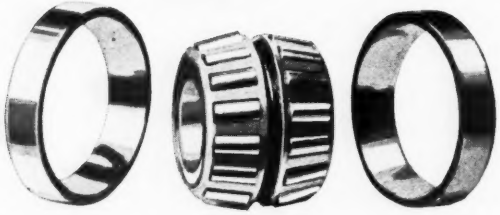
Tapered Roller TIMKEN BEARING EQUIPPED

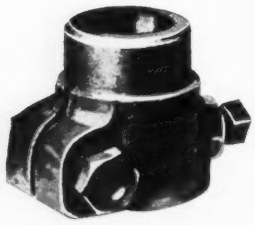
The Crankshaft



Model 52 Fairmont car with Timken Bearings on axles, engine crank shaft and belt pulley.

Here's Real Protection for Fairmont Cars





The Axle Assembly

With 12 Timken Bearings protecting every hard service point, Fairmont cars are well able to stand the gaff of this exacting service. The engine crank shaft, axle boxes and belt control pulley are all protected by the exclusive Timken combination of tapered construction, positively aligned rolls and Timken-made special alloy steel, the most wear-resisting material ever developed for anti-friction bearings.

That means many extra years of economical service—for radial loads, thrust loads, shock, friction, abuse and neglect are completely and permanently overcome.

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TIMKEN *Tapered Roller* BEARINGS